Compressed Air Magazine

Vol. 43, No. 12 | London - New York - Paris | December, 1938

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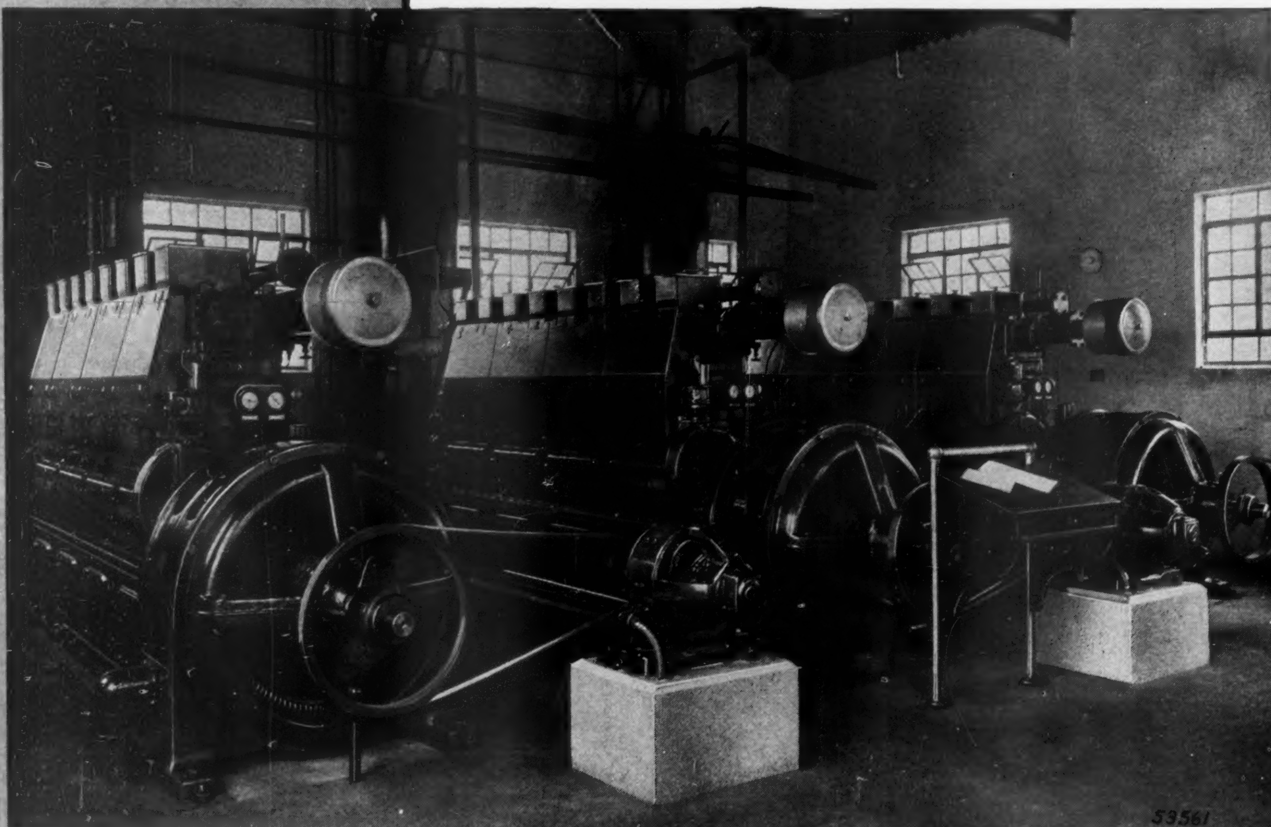
7 months without a stop

with these three Type "S" HEAVY-DUTY DIESEL ENGINES



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ON THE COVER

CONCRETE is being placed on the record-size Grand Coulee Dam from a 36-foot-wide steel trestle spanning the valley of the Columbia River. Compressed air, which is utilized in many ways, is distributed throughout the working area by lines running out along this trestle and having take-offs at various points. Our cover picture shows a workman attaching a hose to one of the several outlets of a manifold underneath the deck of the trestle. Acknowledgment for the photograph is made to Acme Newspictures.

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IN THIS ISSUE

LONDON Bridge is undoubtedly the best-known river crossing in the world. It is perhaps not generally realized that the present bridge is at least the seventh structure to be erected at the same location and that its predecessors played an important part in British history over a span of many centuries.

●

THE difficulties of getting about the forbidding northern expanse of Canada in wintertime has seriously hampered the economic development of that vast region. Now, however, the internal-combustion engine has been adapted to propel various types of aerial and land vehicles that provide dependable regular travel and transport service to far-flung outposts.

●

PICTURE pumping more than 7,000 tons of water daily for nearly ten months to the top of a structure more than twice the height of the Empire State Building in New York City. Stripped of details that is what was done in unwatering the Isle Royale Copper Mine. For the complete story see page 5761.

●

A GROUP of men have invested $500,000 in two unusual aquariums, in Florida, where 2,500 fishes of 75 different species have been harbored for visual and photographic study. It is expected that much not known about the creatures of the sea will be disclosed through the venture.

●

IN THE second of a series of five articles, R. C. Rowe continues his record of the foundation and growth of gold mining in western Canada. Next month he will shift the scene to Yukon Territory.

Compressed Air Magazine

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EDITORIAL CONTENTS

ADVERTISING INDEX

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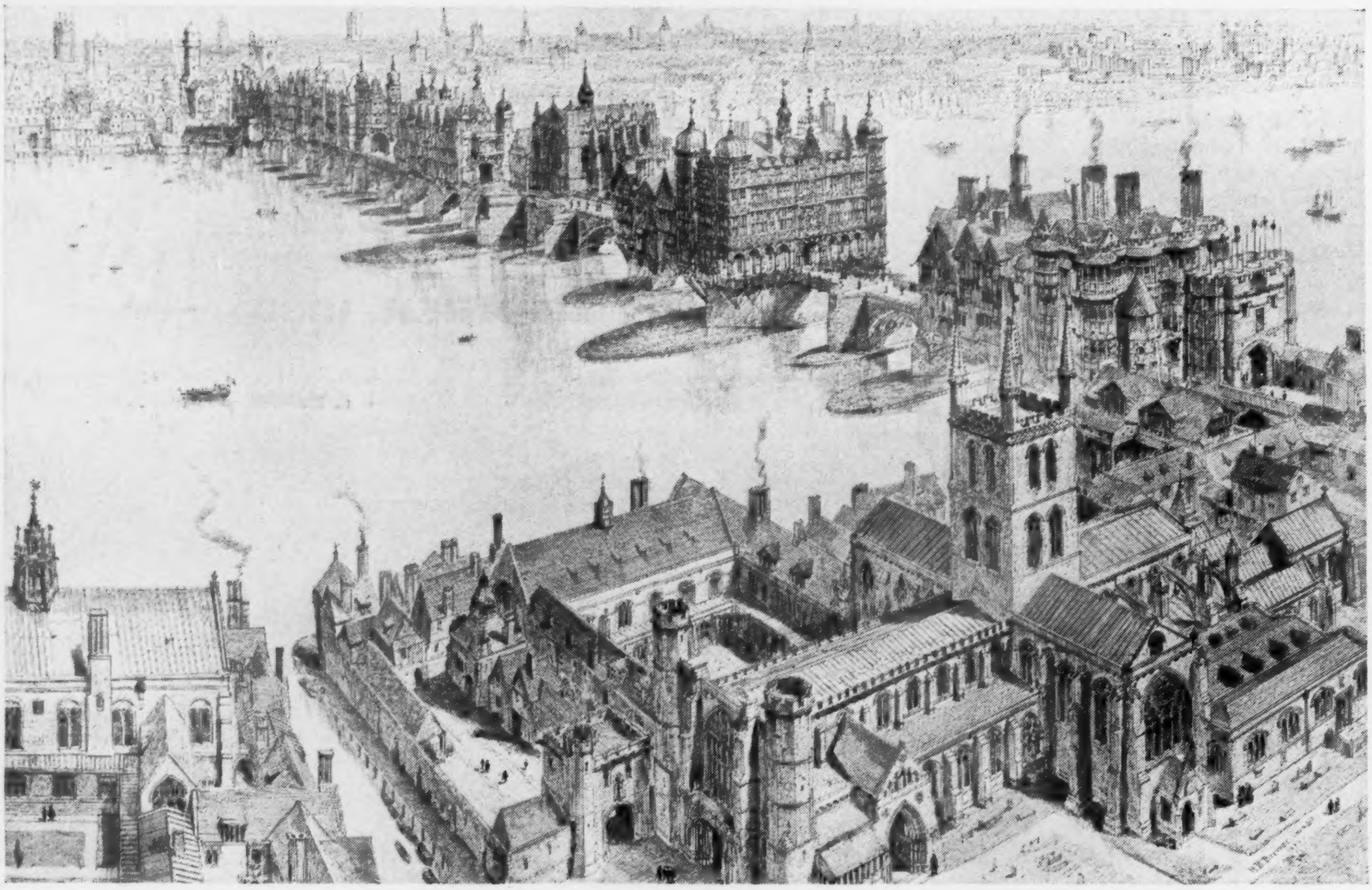


OLD LONDON BRIDGE

This structure, which was completed in 1209 after 33 years of work stood until the present London Bridge was opened to traffic in 1831. Up to 1750 it was the only crossing over the Thames in London. Clusters of piles were capped with timber platforms, and on these were built masonry piers to support nineteen short, irregular arches. The aggregate available waterway was restricted to 300 feet, or about one-third of the normal width of the river. After the manner of the times, a jumble of frame buildings was erected on the deck of the bridge, which was a town in itself, with its own stores and even a church. Several thousand persons made their homes in this unusual community, and some of them seldom if ever left it. The picture is of a model of the structure that is owned by a London publication, "The Builder," and that will be exhibited at the Golden Gate Exposition in San Francisco, Calif., next year.

Historic London Bridge

Roy E. McFee

THE history of London Bridge covers a full 2,000 years. This bridge had its vague beginnings back in the days when the first Britons roamed through forests that crowded to the river banks. Its rude timbers spanned the Thames intermittently during three Roman invasions and through countless raids of Saxons and Danes. It saw the Norman army land on the coast and march to Hastings. It watched explorers and colonists go out to a new world. It witnessed the dawn of the twentieth century. Throughout those slow generations it has become not only the landmark of English-speaking peoples but, indeed, the saga of bridge engineering itself.

The story of London Bridge is not the story of a single structure. Obviously, no one structure could have carried London's increasing traffic for twenty centuries. Rather, it is the story of a succession of bridges at that particular crossing. Time after time, either because of destructive forces or as a commercial expedient, an existing structure has yielded to another. The present one is at least the seventh, possibly the eighth, bridge to span the River Thames at that point.

Whether or not the first London Bridge was built by the primitive Britons themselves, is uncertain. It has been asserted that the Roman Emperor Claudius found a rude but substantial structure across the Thames when he invaded England in A.D. 43. The exact location of the supposed bridge is not clear in the ancient writings; but there is good reason to believe that it was near the site of all the recorded London bridges. At that time the science of bridge engineering was well developed on the Continent of Europe, and it is reasonable to suppose that the early Britons also were sufficiently advanced in the art and therefore were the first to span the river.

The first London Bridge of which there is definite knowledge was constructed by the Romans. That was during their occupation of Britain in the early years of the Christian Era. Inasmuch as that occupation was in the nature of a conquest, the bridge was for military purposes It was a temporary structure of the pontoon type. Heavy rafts were anchored in the stream at fairly regular intervals to form a row of supports from shore to shore. The spaces between them were spanned by timber beams upon which rested the plank flooring. The result was a continuous, floating passageway which swayed and tossed with the waves but, nevertheless, withstood the tread of the Roman legions and the impact of their army vehicles. Such a temporary bridge must have required continual maintenance. It was exposed not only to the battering of floods and tides but also to the attacks of hostile armies. No doubt many of its timbers were

LONDON BRIDGE

This famous structure was designed by John Rennie, who died soon after finishing the plans in 1821. Its construction was carried out by his sons, John and George, and it was completed in 1831. It is built of granite throughout. The large building is Adelaide House; and at the left of the bridge stands Fishmongers' Hall.

swept away during those tempestuous years, perhaps to be tossed later upon distant shores. After the Romans withdrew from Britain, in the year 410, their pontoon bridge was left to the mercy of the elements. Eventually its moorings failed, and it floated out to sea.

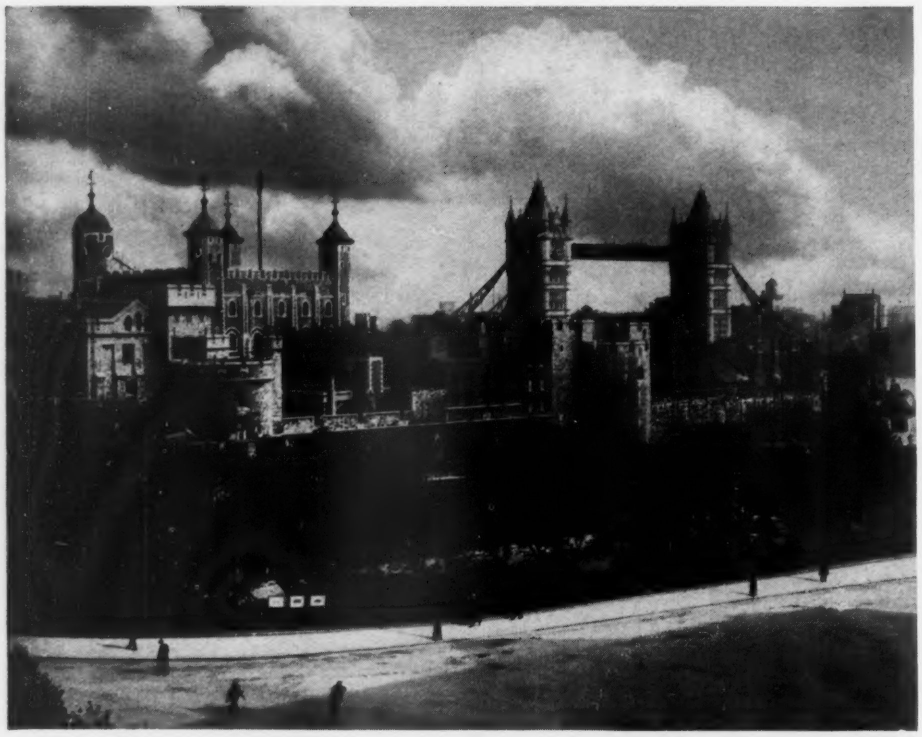
Some time later the Saxons came to Britain. Those fair-haired men from the forests of northern Germany likewise built timber bridges, but of more enduring design. Long timber piles were driven securely into the river bottom and capped to form bents spaced regularly across the stream. This work, with the primitive equipment available, must have presented great difficulties. Four bridges were constructed by the Saxons on the same site. The first one was fortified against the invading Danes. When the commander of the Danes arrived with his forces, he promptly attached his boats to the structure and pulled it down. That was in the year 994. When King Canute himself came to Britain, in 1016, he found that the Saxons had erected a second bridge. Not to be stopped, yet realizing the value of the structure, he finally ordered a canal dug around the south end of it, and through that canal passed the Danish naval array on its ambitious project of uniting Denmark, Norway, Sweden, and England into one great northern empire. The second bridge stood until shortly after the Battle of Hastings, when it was swept away by the tide. The third was destroyed by fire, and the fourth and last one was torn down.

The Norman Conquest was bound to effect every phase of English life, not even excepting London Bridge. When Edward the Confessor, King of England, died, William the Conqueror, at the head of some 20,000 Normans, invaded that country and seized the crown for himself. The significant feature of that conquest was that Duke William and his army were of the same blood as the conquered people: they simply spoke another tongue and perhaps had wider viewpoints. William made his men nobles and settled them on landed estates. Thereafter English life acquired stability, and before long England herself became a world power.

About that time the need for a more permanent bridge across the Thames became apparent. On first thought it may seem remarkable that the necessary initiative for that enterprise should have been supplied by the chaplain of St. Mary's, Peter of Colechurch. However, in those days churchmen often became public leaders. Under the direction of Peter of Colechurch the structure was begun in 1176. Little is known about the actual labor involved; but the best available engineering skill must have been employed. It was completed in 1209, after 33 years of work. Its builder died about that time and was buried in a crypt in the center pier. This was the famous London Bridge about which children centuries later were to sing "London Bridge is falling down."

This sixth, or possibly seventh, London Bridge was of substantial construction. Large elm piles, in groups, were driven their full length into the river bed. On the heads of these piles were placed heavy timber platforms, and on these, in turn, were built stone piers which rose out of the water to support a series of short, irregular arches. The resulting structure was a massive, imposing expanse of masonry, but was of rather crude architecture.

Many of the details about this first permanent London Bridge are available, having been recorded in 1746 by Charles Labelye, a civil engineer with a fitting sense of the historical who took the dimensions of this structure. It was 936 feet long, and had nineteen arches. These varied in length from 15 to 34 feet without regard for balance, proportion, or harmony. Nor were any two piers of the same width. Combined, they were 420 feet wide, leaving waterway openings with a total width of 516 feet. The latter were reduced still



TOWER BRIDGE

The famous Tower of London, with the Tower Bridge at the right. The Tower and its surrounding wall were built by William the Conqueror. Just beyond the roadway is the old moat. The Crown Jewels are still kept in one of the wall towers. The premises are garrisoned by one of the four regiments of the King's Guard: Irish, Scotch, Welsh, and Coldstream. Tower Bridge was opened in 1894.

further by pile fenders that were designed to protect the piers from damage by ice and ramming boats. Actually, the available waterway was only about 300 feet wide, or approximately one-third the width of the river. The restricted spaces had to carry not only the flow at normal and at flood stages but also the tides which raced in and out through the openings. Often the roar of the water under the bridge was like thunder. The increased rate of flow of the water was an added menace to the heavy river traffic, already dangerously congested in the narrow channels.

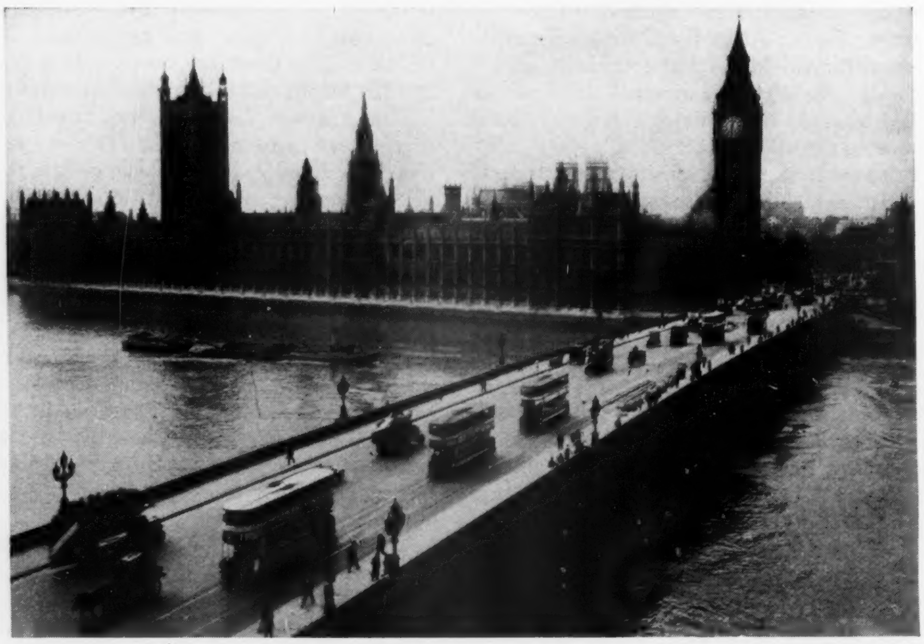
The really distinctive feature of the structure was its deck. Almost from one end to the other the narrow roadway was flanked on both sides by an amazing jumble of frame buildings from four to six stories high. Indeed, with the exception of the lower floor, these ornate and grotesque houses spanned the entire bridge, turning what was left of the deck into a covered way. To the casual glance, with its weird groupings of chimneys, balconies, towers and spires, the bridge had the appearance of a Norman castle rising from a rocky river bank.

Altogether there were about 100 separate and distinct buildings. Generally, the first floor was occupied by stores and shops, while the upper floors served as dwellings. Some of the houses had basements in the piers. Of a total deck width of 70 feet, only about 20 feet remained for a roadway. There was no footwalk. In consequence, through the narrow passageway poured a continual stream of motley traffic—men, women, and children mingled with carts, mules, and pack horses.

One building deserves particular mention. It was the beautiful Chapel of St. Thomas à Becket, at the center of the span, in which services were held regularly. On Sunday it was attended by throngs of pilgrims, crusaders, and others who often came from afar. They either joined the traffic on the bridge or reached the church by boats, using an entrance on the water side.

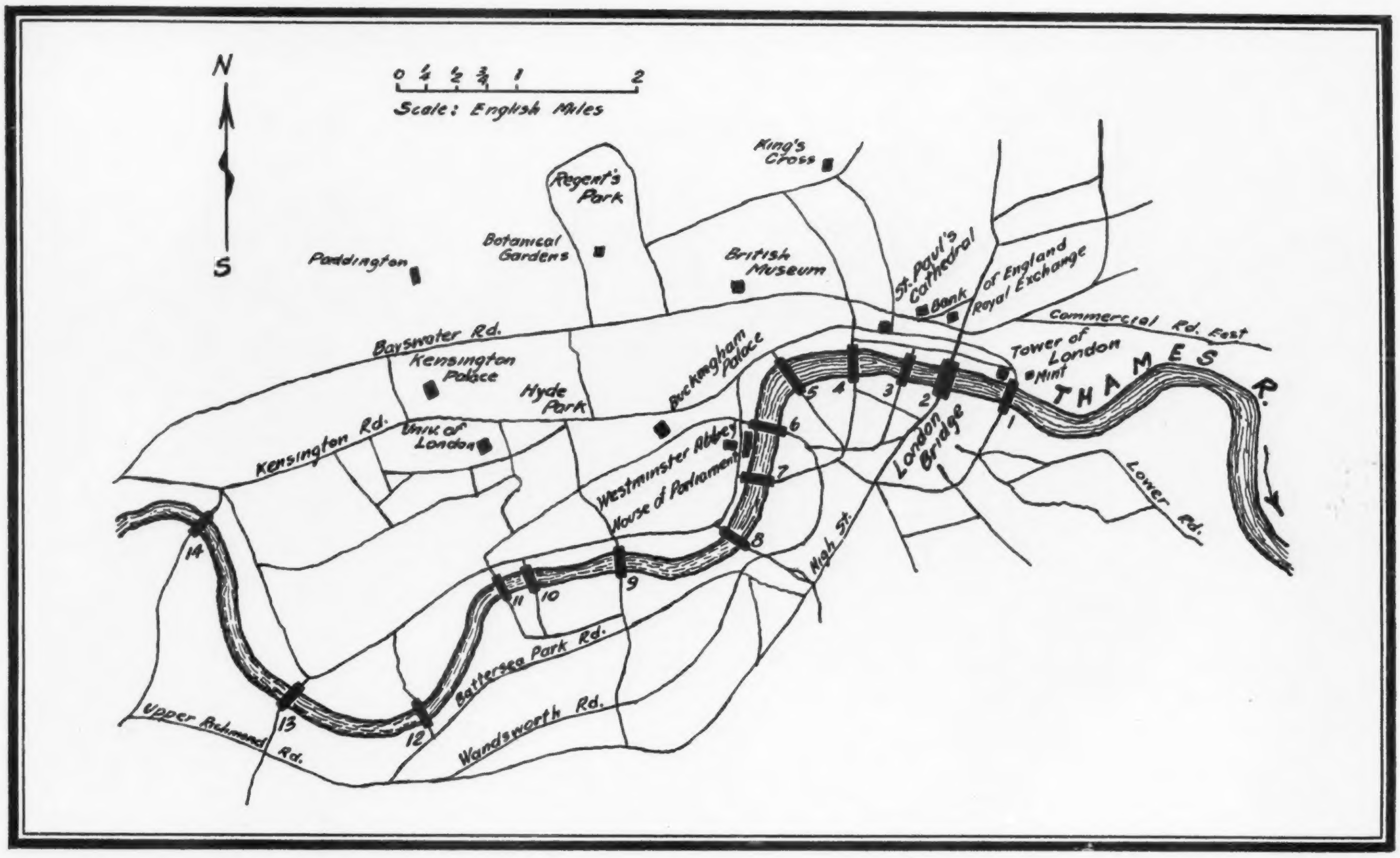
The dwellers on the bridge numbered thousands. With both homes and shops on the structure, humanity there swarmed like bees in a hive. Mark Twain, in *The Prince and the Pauper*, has this to say about it: "The Bridge was a sort of town to itself; it had its inn, its beerhouses, its bakeries, its haberdasheries, its food markets, its manufacturing industries, and even its church. It was a close corporation, so to speak, it was a narrow town, of a single street a fifth of a mile long, its population was but a village population, and everybody in it knew all his fellow-townsmen intimately, and had known their fathers and mothers before them—and all their little family affairs into the bargain. It was just the sort of population to be narrow and ignorant and self-conceited. Children were born on the Bridge, were reared there, grew to old age and finally died without ever having set a foot upon any part of the world but London Bridge alone. Such people would naturally imagine that the mighty and interminable procession which moved through its street night and day, with its confused roar of shouts and cries, its neighings and bellowings and bleatings and its muffled thunder-tramp, was the one great thing in this world, and themselves somehow the proprietors of it."

Astonishing as the situation was, there



WESTMINSTER BRIDGE

On the opposite bank are the Houses of Parliament and, at their right end, the famed clock, Big Ben, which is visible and audible at a considerable distance. Left of the tower, in the background, are the shadowy outlines of the twin spires of Westminster Abbey. The original Westminster Bridge, which was the second Thames' crossing in London, was opened in 1750 and presented a view that inspired Wordsworth's sonnet, "Lines on Westminster Bridge." The structure was rebuilt in 1862.



HIGHWAY BRIDGES ACROSS THE THAMES IN LONDON

The numbers indicate the locations of the following bridges: 1– Tower; 2– London; 3– Southwark; 4– Blackfriars; 5– Waterloo; 6– Westminster; 7– Lambeth; 8– Vauxhall; 9– Chelsea; 10– Albert; 11– Battersea; 12– Wandsworth; 13– Putney; 14– Hammersmith. Several railroad bridges are not shown; and there are other bridges outside the area mapped.

was of course some explanation why people should live and work on London Bridge. It was customary at that time throughout Europe, especially in Paris and in parts of Italy, to use bridges in that way. They offered good air, despite congested conditions, also an abundance of water and a ready means of waste disposal. There, too, modern methods of sanitation and water supply probably had their beginning. In fact, at the north end of the structure was installed a water works. Great water wheels, with broad paddles, were turned by the water passing through one of the openings. The wheels operated pumps, and the latter forced the water through lead pipes. Thus a large part of London was supplied with running water even in that early day.

London Bridge was then literally the south gateway to London proper. Many times in the past the site had been the scene of clashes between invaders and defenders. Moreover it was still the period when war was waged by surprise attack. Therefore the military authorities made sure that the new bridge was fortified. High defense towers of stone were erected at both ends, and for added protection a wide drawbridge was built into one approach. These towers remained as a symbol long after they had outlived their usefulness. In 1588 the south tower was decorated with eleven standards captured from the Spanish Armada.

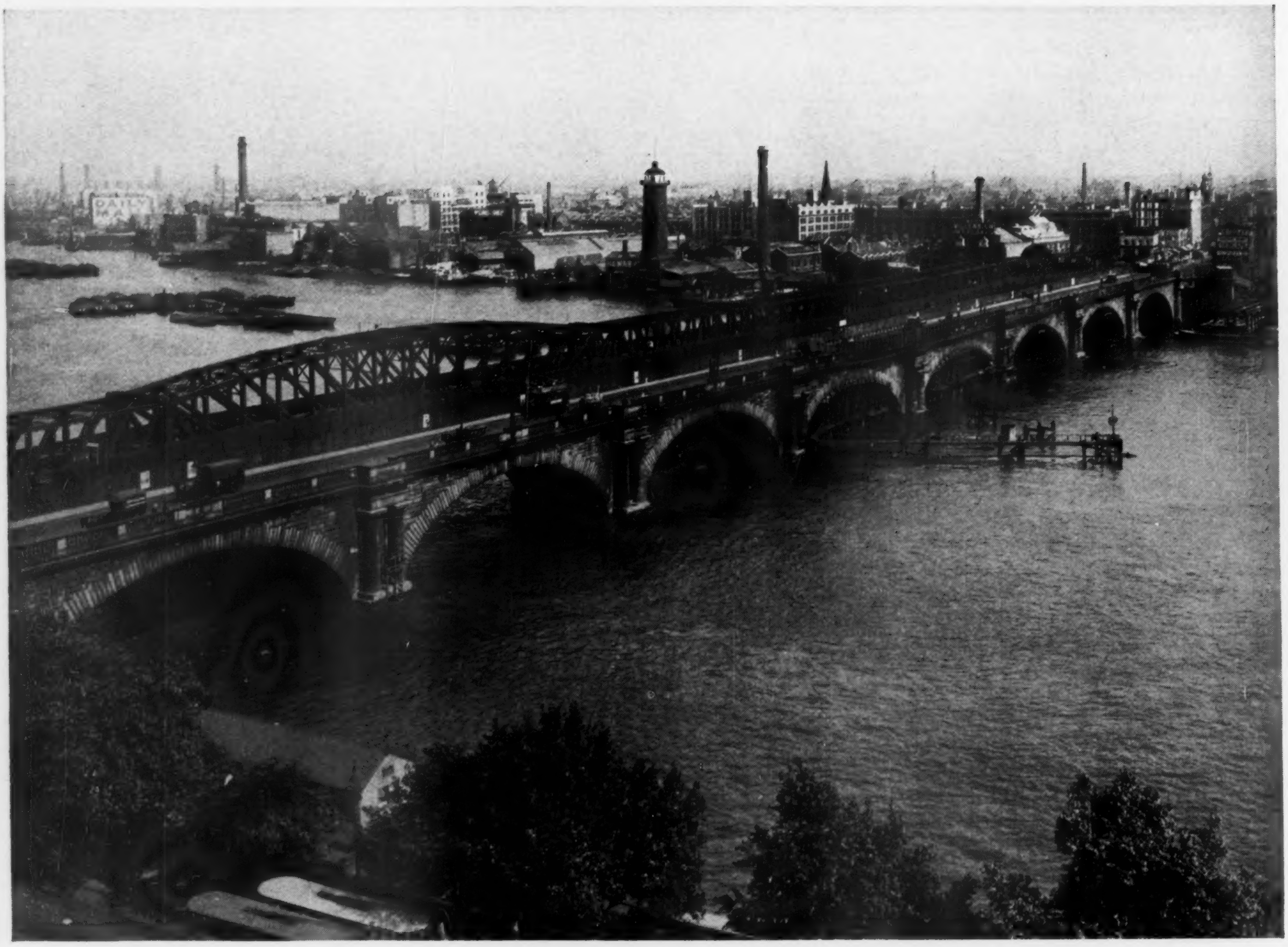
Naturally, the bridge was able to provide a steady income both in rents from the occupants of shops and dwellings and in tolls collected from traffic crossing the structure. However, not all tolls collected were legitimate. It was the heyday of the highway robber, when there was no aversion to taking any possible fees. So, for a while, river traffic passing under the bridge was actually assessed, an imposition which was the greater because the bridge was no aid to navigation, on the contrary, was a real obstruction.

As might be supposed, the timber buildings were a constant fire hazard, and, indeed, destructive conflagrations almost without number raged on the structure. History notes especially those that took place in the years 1212, 1504, 1632, 1666, and 1765—covering a period of more than 500 years! In 1666 was the Great London Fire which destroyed half of the homes on the bridge. Several times fires began on both ends at once, trapping the inhabitants. Altogether, thousands of persons thus met their death on London Bridge.

There was still another menace. To acquire more space, many of the houses had been built out over the water on supporting brackets. This cantilever method of construction necessitated expert designing and continual maintenance, if collapse was to be averted. As it happened, the brackets often were not strong enough to bear the superimposed loads; and, doubtless, had additional burdens placed upon them without further investigation. This was proved when brackets failed, plunging tenements into the water without warning and with appalling loss of life.

Finally, in the early nineteenth century, it was determined to replace the bridge with another one. It had seen 600 years of service! It had once echoed to the tramp of crusaders marching out of London toward the Holy Land, and yet it had remained to see Wellington return victorious over Napoleon. For the first five centuries it had been the only crossing over the Thames in London; and even during the last 100 years it had been the city's principal thoroughfare across that stream.

During that last century other bridges had come into being there. The two most recent ones were Waterloo Bridge, built in 1817, and Southwark Bridge, constructed two years later. Both had been erected by John Rennie, the famous British civil engineer who was making a name for himself as Britain's pioneer builder of modern bridges. He had studied at the University of Edinburgh, and in 1791 had begun his bridge-engineering career in London. After years of professional distinction, Rennie



WATERLOO BRIDGE

This structure, which is the oldest of the Thames crossings, is now being demolished, as a new bridge has been erected. More than ten years ago, the two arches under which the timber falsework is shown were weakened by the wash of the river. Thereupon the traffic was lightened by making the crossing a 1-way thoroughfare, and the structural-iron span adjoining it was built as a temporary means of accommodating counter traffic. Because of the antiquity and architectural beauty of the bridge, Londoners were loath to destroy it, and various plans to rebuild it were considered before it was decided to replace it with a modern structure. Building of the new bridge was started at a nearby location about two years ago. At the far end of the crossing is Waterloo Station, the terminal of most of the transatlantic boat trains that enter London.

reached the zenith when he was chosen to construct the new London Bridge.

He accordingly set about to design the new structure. Departing widely from the old London Bridge, the plan for the new one called for five elliptical arches varying harmoniously in length from 152 feet, for the center arch, to 130 feet for the end arches. The height above the river was 56 feet. The piers were well proportioned, and not wide enough to hinder the stream or shipping. The bridge was of granite throughout. Needless to say, there were no buildings on it, the deck lying open to the sunlight so that its entire width was available for the growing travel across the Thames. Above the sweeping curve of the deck proper towered lamp posts made from French cannon captured in the Peninsular War.

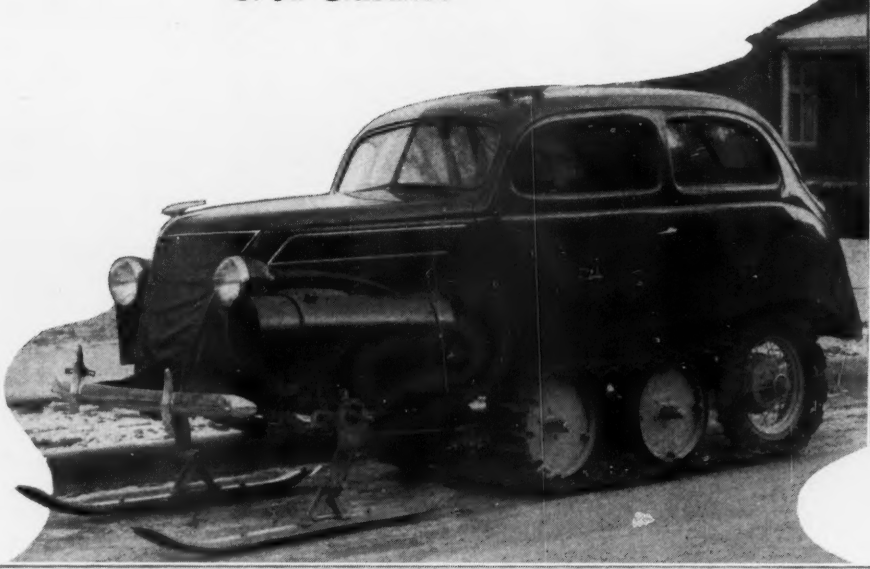
John Rennie finished the design and died in 1821; but he had seen his vision. He was buried with honors in St. Paul's Cathedral. The actual construction of the bridge was undertaken in 1824 by his sons John and George. The location selected was about 200 feet up the river from the old structure so that it might continue to serve until the new one was ready to take the traffic. It is noteworthy that in excavating on the site there were uncovered Roman coins that had supposedly been lost there in the course of construction work done at least fifteen centuries before. The new bridge was finished in 1831 after seven years of building and at a total cost of $7,000,000. In August of that year it was opened with pomp and ceremony by King William IV and Queen Adelaide. This was six years before Victoria began her long reign as Queen of England.

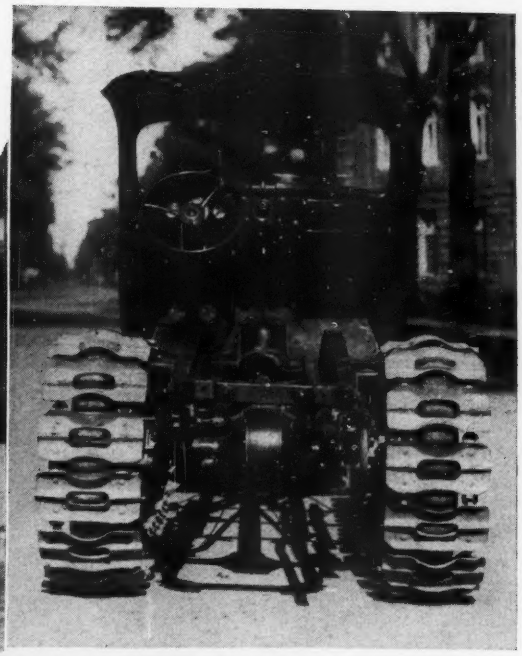
Since the last London Bridge was finished, London's amazing growth has required still others to carry the traffic across the Thames. At the present time no less than fourteen highway bridges span the stream in that great metropolis. Of these, Waterloo Bridge is the oldest structure, being fourteen years older than the new London Bridge. In 1894 the Tower Bridge was built downstream from London Bridge: the other twelve are upstream. Mark the names: Southwark, Blackfriars, Waterloo, Westminster, Lambeth, Vauxhall, Chelsea, Albert, Battersea, Wandsworth, Putney, Hammersmith—all truly English names that blend into the picture of Britain's wide sphere of influence.

But dominating them all, even in this age of steel and concrete, is London Bridge, standing venerable among its giant brood, and a worthy successor of two millenniums of notable bridges. Not only is it secure in historical renown, not only is its architecture pronounced to be of the highest order, but, today, a century after its building, it remains an indispensable structure at London's ancient river crossing. Within the shadow of modern marts and exchanges it spans the Thames as of old: on England's earliest footpath it carries the traffic and commerce of the world's greatest city.

Revolutionizing Winter Travel in Canada

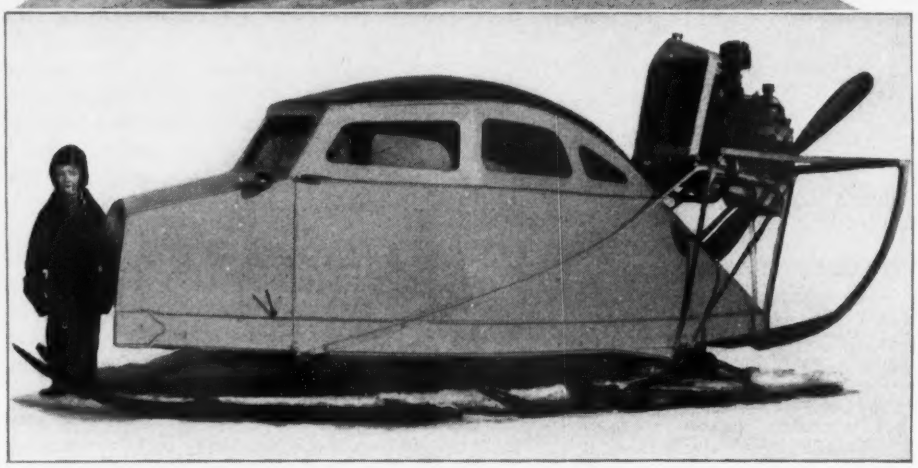
E. L. Chicanot





THE SNOWMOBILE

By making the changes shown at the left, a standard automobile may be converted into a dependable and comfortable winter conveyance that can travel up to 50 miles an hour. It can readily be reconverted into its original form for summer travel. Above is a rear view of the chassis of a Snowmobile.



THE AEROMOBILE

An automobile body mounted on skis and driven by an airplane propeller. Some users consider this type of vehicle superior to the Snowmobile for winter travel.

OUTSIDE of the few large centers of population, and away from the host of minor towns and villages strung along the meager skeleton of the longitudinal railways, winter travel and transportation in Canada have had to contend with physical difficulties and hardships greater, in all probability, than those encountered in any other part of the globe. The combination of frigid temperature, deep snow, unsurveyed expanse, and rugged topography is, even in imagination, sufficient to daunt the staunchest soul and, in actuality, only to be challenged by the hardy and intrepid.

As one envisages such journeying, with the wind howling round the house and the powdered snow tapping ghostly messages on the window, one draws with a shiver closer to the fire and stirs the logs there, giving thanks that one is not among those who must battle those elements in the course of duty. The Canadian winter outdoors can be enjoyable, with thrilling and exhilarating sports to be had in one's backyard or in the nearby countryside, with the clutch upon civilization never entirely relinquished; but this refined and briefer acquaintance with the elements only serves to make one feel more keenly for those whose lot takes them beyond civilization's rim where they must endure inclement weather conditions at their bitterest as a matter of course.

There are many who must perforce suffer the rigors of the Canadian winter in all their intensity in that vast Canadian expanse that lies beyond lines of steel. Among them are the trader and the trapper, the mounted policeman, the doctor, the prospector, the mining man, and the timber and pulp and paper worker. For such persons, winter travel and transportation have, in the past, not only been definitely arduous but frequently terrifying and occasionally tragic. Altogether, the combination of difficulties to be overcome in moving over this expanse throughout the greater part of the year has constituted the most serious handicap to speedier economic development and to the exploitation of the varied resources of a rich if forbidding land.

From earliest times until after the World War the only means of travel and transportation in the winter months off the beaten paths of civilization were by foot, on snowshoe, and with dog team. It was slow and grueling going at the best; and the fullest apprehension was justified as one plunged into a subzero temperature over an unrecognizable stretch of snow, with the imminent possibility of blizzard or other hazard. It was also, of course, inefficient an uneconomic transportation by any standards elsewhere. Little wonder that all the freighting and journeying that could then be accomplished were done in the summer time when the innumerable rivers and lakes rendered those operations comparatively easy and efficient. Nevertheless, there was much necessary movement in the months between the early fall and the late spring for which there was no alternative to the primitive, traditional means of conveyance.

The development of commercial aviation in the period since the end of 1918 has revolutionized the situation so far as long-distance travel and light transportation

WINTER HAULING OPERATIONS

Black spruce logs for paper-making being hauled over a snow road in Ontario by a 35-hp. diesel-engined tractor. Six round trips of 5 miles each are normally made in a 10-hour day, the total daily haulage being from 75 to 100 cords. Some companies that regularly employ this sort of equipment apply water to the roadway to produce a coating of ice over which the sleds will slide easily. Formerly logs had to be snaked out of the woods one by one, with horses. The upper picture shows mining machinery being hauled to the Patricia mining district in Northwestern Ontario. On the front sled is a Canadian Ingersoll-Rand steam-driven air compressor, and back of it are the boiler, stack parts, etc. Such trains always travel in pairs, known as a "swing."

are concerned. Not only has the airplane thrown the long-established mediums almost completely into the discard but it has opened up to exploitation large sections of the North where economists did not expect it for at least half a century. The vast subarctic, stretching away from where settlement dwindles beyond the railways paralleling the international boundary, and which according to the map is uninhabited and unproductive, is a mass of sporadic and varied activities connected for all practical purposes by a network of airlines. It is significant that without possessing any means of air travel between her main centers of population, Canada leads the world in the volume of freight moved by air, and this by reason of the supplies carried into the Northland to support undertakings there and the products of the area which are brought out.

A journey in the dead of winter from the outpost of Edmonton to within a few miles of the Arctic circle where radium ore is being mined, and where the thermometer sometimes registers 72° below zero Fahrenheit, can today be made in the same comfort that travelers between Montreal and Toronto enjoy in the regular trains. Now the mounted policeman depends largely upon the airplane to make the long jumps of his patrol. In the fall the trapper is flown, together with his paraphernalia, to his line of traps; and later the fur trader goes in by air to return with the harvest of peltry. Planes regularly supply mining companies with many of the necessities of operation and carry out the high-grade ore, while wilderness workers receive mail and get bi-weekly consignments of fresh meat, vegetables, and other needs of civilization. The flying machine has not only rendered Northland activities efficient beyond the dreams of a few years ago but has robbed winter travel of its hardships and suffering and in their place has put convenience and comfort.

One of the greatest services the plane has rendered because of its speed and ease of travel, and of which comparatively little is heard, is its humanitarian work for the sick and injured. Formerly, in the absence of medical attention and hospital facilities, a man who became seriously ill or suffered injury in the remote fastnesses stood little chance of recovery in the season when transportation over land and water, itself extremely hazardous under the circumstances, was altogether impossible. Today, in such an emergency, a doctor is flown in, or the afflicted person is carried with little delay to a hospital on the fringe of civilization. One company alone, which is responsible for the major amount of flying in the Northland, engages each year in more than 100 "ambulance cases" or "mercy flights," as they have come to be termed, over distances ranging as much as 1,200 miles.

But while the machine of the air solved the problem of winter and light transportation between civilization and outlying regions and between the scenes of isolated activity in the hinterland, it did not touch the matter of heavy freighting for new mining or forest enterprises or of travel in that intenser sphere of economic development just beyond the fringe of settlement. Movement of the myriad requirements of newborn mines hastening to the production stage, the operations of workers taking toll of the forests to supply the huge pulp and paper plants, were restricted by the limitations of horse and dog transport. The policeman on patrol on the frontier's edge still had to depend on snowshoe and dog team. The doctor to reach a patient had to have neighbors clear a path for him, or plow a treacherous way round drifts.

Heavy hauling from railway to mines and to logging scenes, where there may or may not be crude roads cut through the bushland, is a vital problem and can in many cases be undertaken only in the winter months. It is being generally modernized as the inefficient and uneconomic horse and sleigh are increasingly being discarded and the crawler tractor is coming into ever wider use. In many respects the tractor may be considered the complement of the airplane in the transportation of loads heavier than those possible or economical by air; and in certain cases both forms are engaged in and controlled by the

AN AERIAL FREIGHTER

An isolated settlement, showing groceries and other supplies that have just been unloaded from the airplane. Above is a base of operations for planes that carry freight from the end of steel at Waterways, Alta., to mining camps in Northwest Territories. Canada leads all nations in the amount of aerial freight carried.

same company, the one naturally fitting into the other.

In many sections of the Northland, crawler-tractor trains operate continually all winter between the railway and outlying mines or other frontier enterprises. A train is made up of a tractor and four or six sleds, weighing in all between 30 and 50 tons. Tractor trains go in pairs known as a "swing." At the end of each train is a caboose in which the members of the crew rest, sleep, warm themselves, and eat. A crew consists of two drivers and two brakemen, and there is a foreman in charge. The "swing" travels without a stop day or night, and the trips consume from 40 hours to a week. The duty shift depends on how long the men can stand the cold.

If one has the faintest conception of what winter in the Northland is like it is easy to understand why tractor trains operate in pairs. There are generally no roads, and, broadly, the trains cover the shortest distance between two points, advantage being taken of the unimpeded surfaces of the waterways with which the region is meshed. Lakes are frozen to a safe depth to support the huge trains; but, nevertheless, cracks concealed beneath slush may unexpectedly be encountered. Hauling tractors out of holes in the ice is therefore part of the routine technique. When such need arises the two crews help each other; and when there is a portage to be negotiated both tractors are hitched to each train in turn to get it over the hump.

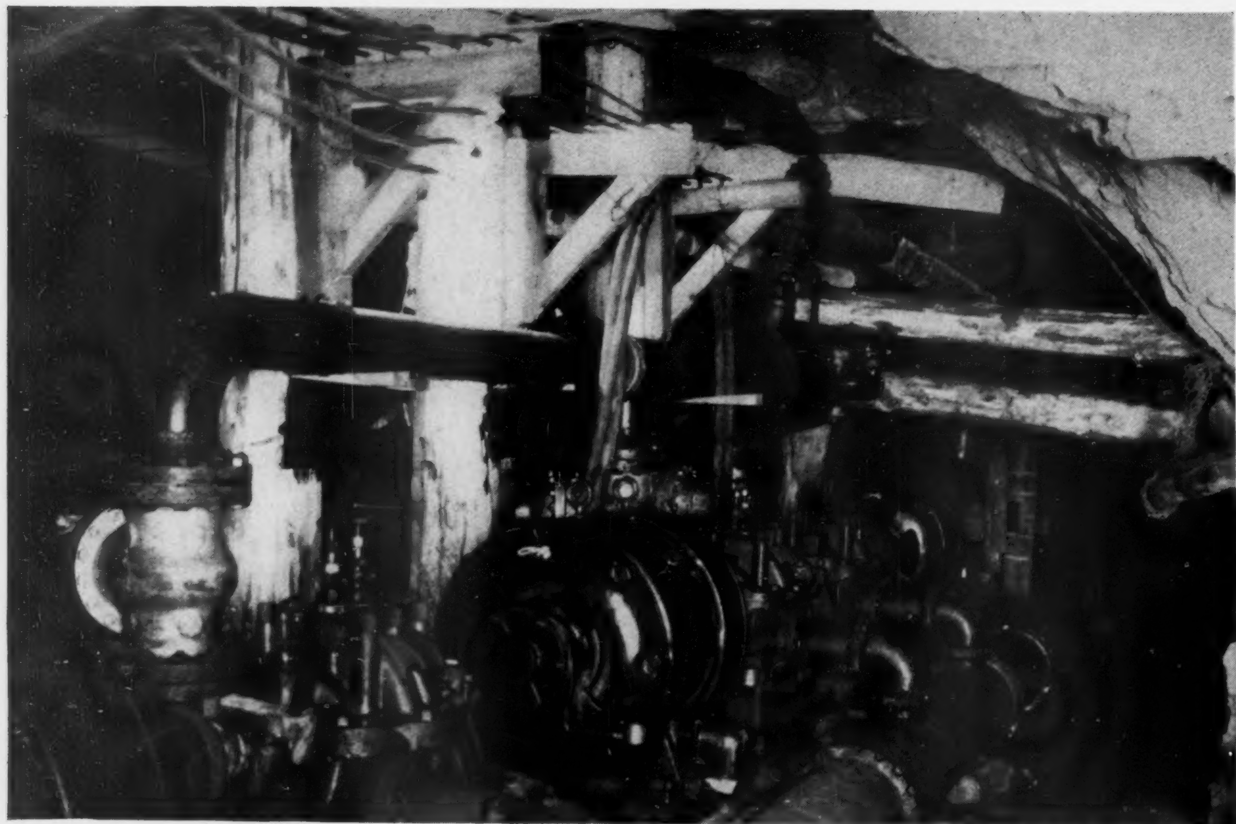
Companies pursuing their activities in forests during the months of heavy snow also have adopted this type of tractor on a wide scale, and lumbering operations are considerably speeded up in consequence. The tractor makes its own trail, and is not dependent on a surveyed road or open highway. Where not so long ago logs were individually snaked out of the woods by horse team to lakes and rivers to await the spring break-up, now some two to four sleds, each heavily loaded with logs, are drawn by crawler tractor from the forest to the ice.

With the crawler-tractor principle proving so satisfactory in the case of heavy winter transportation, it was inevitable that it should be applied to lighter travel for those who have to get about in the country under the severest and most difficult weather conditions. So the Snowmobile came into existence. Putting the automobile on caterpillars, it combines comfort with a capacity to negotiate snow and ice and to go as fast as 50 miles an hour. There are two different types in use. One is a steel caterpillar equipment the gauge of which is considerably narrower than the standard tread of a regular automobile in order that it may conform to the tracks made by the sleighs in general service. In the second, a rubber caterpillar tread in the rear and skilike runners in the front are fitted to an ordinary automobile which can be readily converted back to standard form for summer use.

The Snowmobile is becoming increasingly popular with mounted policemen, doctors, workers for telephone and power companies, timber executives, commercial travelers, and others who formerly had to depend on horses and dogs and open vehicles. Speeding along over hardened sleigh tracks or conquering otherwise impossible drifts, its occupants given complete protection from the elements, this new form of conveyance is becoming a familiar sight in all areas away from the railways. It has wrought incredible changes in the winter routine of many persons.

A newer development along this line is an automobilelike machine which is equipped with skis and which is claimed by many to be superior to the tractor type in deep snow. Its source of power is a gasoline-engine-driven propeller. It weighs approximately 800 pounds, has a seating capacity for four persons, and the steering principle is the same as that applied to an automobile. A foot-operated brake controls steel prongs which dig into the snow. The gas consumption of the vehicle varies from 10 to 15 miles per gallon, according to the surface over which it has to travel; and it can be operated under practically all conditions. In deep snow, where it must make a track, it goes from 12 to 15 miles an hour: on a good hard sleigh track it is capable of making from 40 to 50 miles an hour.

The new snow automobiles are changing not only the face of the Northland in the winter months but also the attitude towards winter travel on the part of those who must undertake it, and, as a result, are revolutionizing living in isolated sections. The worker in frontier places no longer contemplates the prospect of such journeying with trepidation and distaste, knowing that he will not be subjected to the most intense discomfort and that he will in all likelihood get through to his goal. He can drive through roads after storms, when the way is impassable to horses, and, disregarding all developed travelways, go through fields, over lakes, and up hills.



Pumping Out the Isle Royale Mine

*Lucien Eaton**

IN APRIL, 1937, it was decided to pump out the Isle Royale Mine after a shutdown of five years. The mine is in the Michigan copper country just south of the Village of Houghton, and was the first in the district to mine the amygdaloids that carry disseminated copper. It was opened on the Isle Royale amygdaloid, and nearly all the workings are in this lode or its faulted extension, known as the West Vein. The average width of the payable portion of the lode is about 9 feet, although some parts are much wider. The lode has been opened almost continuously for 15,000 feet along the strike and for 4,774 feet on the dip in the middle section. The dip varies from 56° to 51°.

When the mine was closed in 1932 the pumps were removed, and during the idle period little attempt was made to exclude water from the workings. The records kept while the mine was in operation indicated an average underground flow of 300 gpm., and this figure was used in choosing the pumping equipment, although there was a possibility that surface water might have run in as well. When the workings were entered in April, 1937, the water level was about halfway between the 17th and 18th

*General Manager, Isle Royale Copper Company

SURFACE DISCHARGE

Eighteen hundred gallons of water are being discharged here every minute. The pumping continued steadily for 292 days, approximately 7,360 tons being raised daily.

PIPE AT PUMP STATION

Water raised from below was discharged into a sump or reservoir at each pump station. It was then delivered to pumps that lifted it another 600 feet vertically. The picture at the right shows details of the water-column piping at one of these stations.

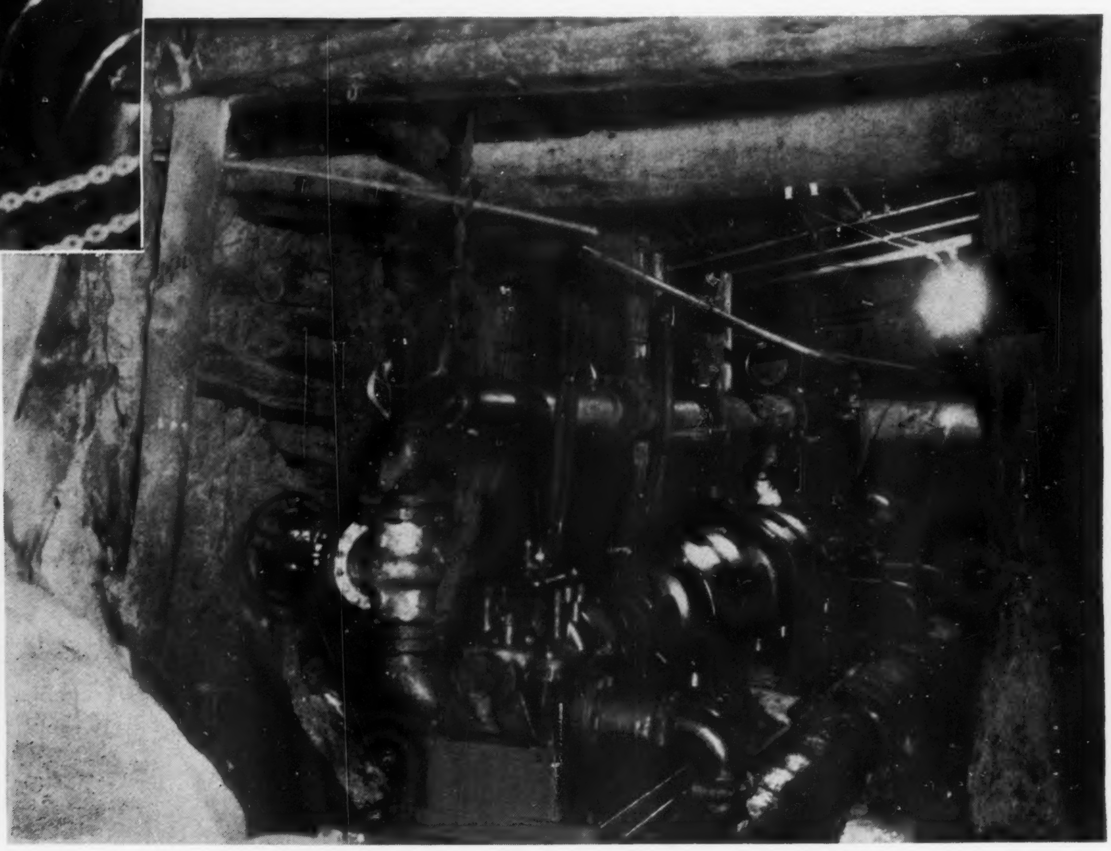
levels, and was rising 5 feet a week. On May 1 it was 42 feet below the 17th level.

The idea of bailing out the water was seriously considered at first; but careful calculations showed that the obtainable capacity would be inadequate, and experience indicated that damage to hoisting equipment and skip roads would be serious. Even if successful, it was doubtful that bailing would be an economical procedure. It was finally decided to use centrifugal pumps and to do the unwatering by way of No. 4 Shaft, the deepest and most centrally located one. Both the shaft and its plant were in reasonably good repair and could be put in working condition by the time pumps could be procured.

To pump out in one year the water that had accumulated in five, and at the same time handle the normal inflow, required the services of pumps with a capacity of about 1,800 gpm., or six times the normal inflow. It was planned to set up station pumps at vertical intervals of about 600 feet, and to use low-head pumps to deliver the water to the station pumps. The interval between levels in most of the mine is 125 feet on the incline and 100 feet vertically: near the surface some of them are farther apart. Consequently, station pumps connected in series were placed on the 5th, 11th, and 17th levels and, as the water receded, another similar station was provided at the 23rd level. Each station was equipped with three pumps, each with a capacity of 600 gpm. against a 600-foot head. At the 29th level, where the workings are much smaller than those above, only two station pumps were set up, moving down two from upper stations for the purpose and reducing the capacity to 1,200 gpm. The same plan was followed at the 35th level.

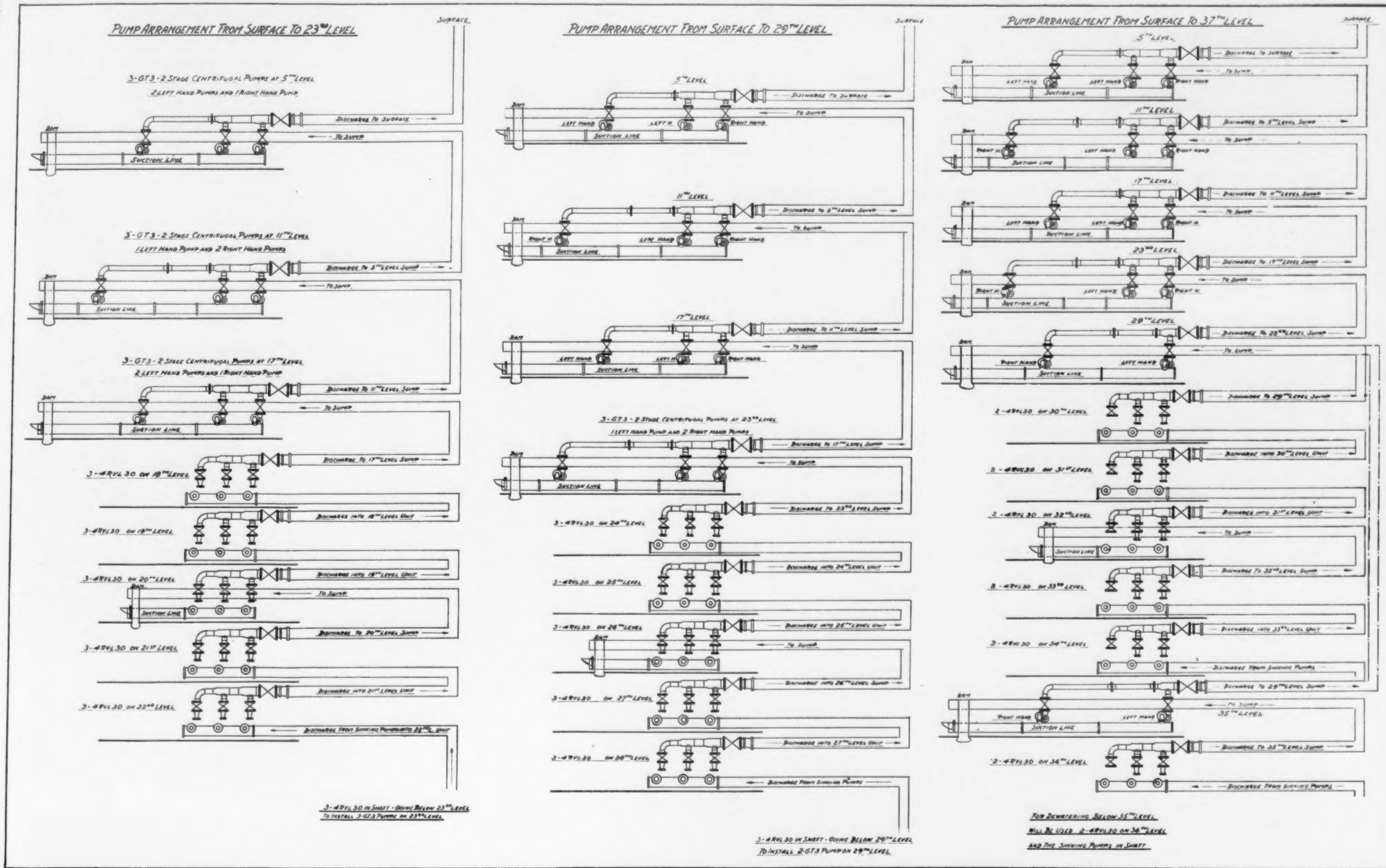
The pumps selected for the stations were Ingersoll-Rand Cameron Type GT, two-stage centrifugals, operating at 3,500 rpm. They were driven directly by 125-hp., 2,200-volt induction motors made by the Louis Allis Company of Milwaukee, Wis. Their starting compensators were furnished by Cutler-Hammer, Inc. There were twelve of these units, six right-hand and six left-hand pumps. One motor and two pump shafts, one with right-hand impellers and one with left-hand impellers, were carried as spares.

Although differing slightly in arrangement, the pump stations were similar in essentials. The pumps were set on concrete foundations about a foot high and with their center lines in line. On one side the suctions were connected to a 12-inch manifold to which 5-inch branches had been welded. This manifold drained the water stored behind a concrete dam on the level and delivered it to the pumps under a slight head. On the opposite side the pumps discharged into a tapered manifold, 6 inches in diameter at one end and 10 inches in diameter at the other, and this, in turn, discharged into the water column. There was a 10-inch Chapman Non-Slam check-valve with a 2-inch by-pass between the manifold and the water column. Experience showed that it would have been better



THREE PUMP STATIONS

As unwatering progressed downward, station pumps were set up at vertical intervals of approximately 600 feet. On the 5th, 11th, 17th, and 23rd levels, these stations each consisted of three Ingersoll-Rand GT 2-stage, centrifugal units having individual capacities of 600 gpm. against a 600-foot head or a combined capacity of 1,800 gpm. Water was delivered to the pumps under a slight head through a 12-inch manifold that was fed from a reservoir made by erecting a concrete dam. The pumps discharged into a manifold that tapered from 6 inches at one end to 10 inches at the other and that discharged into a 12-inch water column. The pictures extending diagonally across the pages show three of these stations. Because of the smaller area of the lower workings only two pumps were erected on the 29th and 35th levels, reducing the capacity to 1,200 gpm.



DETAILS OF PUMP-STATION ARRANGEMENT

These drawings show how the water was progressively lowered through the combined use of twelve Type GT-3 station pumps and eighteen Type 4RVL-30 Motorpumps. When the first of these pumps were started the water was 12 feet below the 17th level, or approximately 1,800 feet below the surface. Three GT-3 units were set up on each of the 5th, 11th, and 17th levels, each group having a lift of about 600 feet. Three 4RVL-30 pumps were mounted on a float which was lowered in the shaft to a point below the 17th level, and these units delivered water to the 17th-level pump station. When the water was below the 18th level, three 4RVL-30 pumps were set up on that level and the pumps on the float then delivered to them. As soon as the 23rd level was unwatered three GT-3 pumps were set up there and the operations repeated, and when the 29th level was reached a 2-pump station was established.

THE WATER COLUMN

The water was raised through No. 4 Shaft, the deepest and most centrally located of the several shafts. The water column was laid between the rails of the north-skip road (below). Nearly a mile of 12-inch pipe was used. The sections were joined by Victaulic couplings. The picture at the right shows some of this pipe on the surface, together with a reel of cable.

to have a check valve between each pump and the manifold, which was fashioned by welding Tube-Turn forged steel elbows and flanged nipples to standard pipe. The reducing sections of the discharge manifolds were made by cutting narrow strips out of standard pipe with a torch, forging the remainder to proper size, and welding the seams. All welding was done with an electric arc welder, and only one of the joints failed under test.

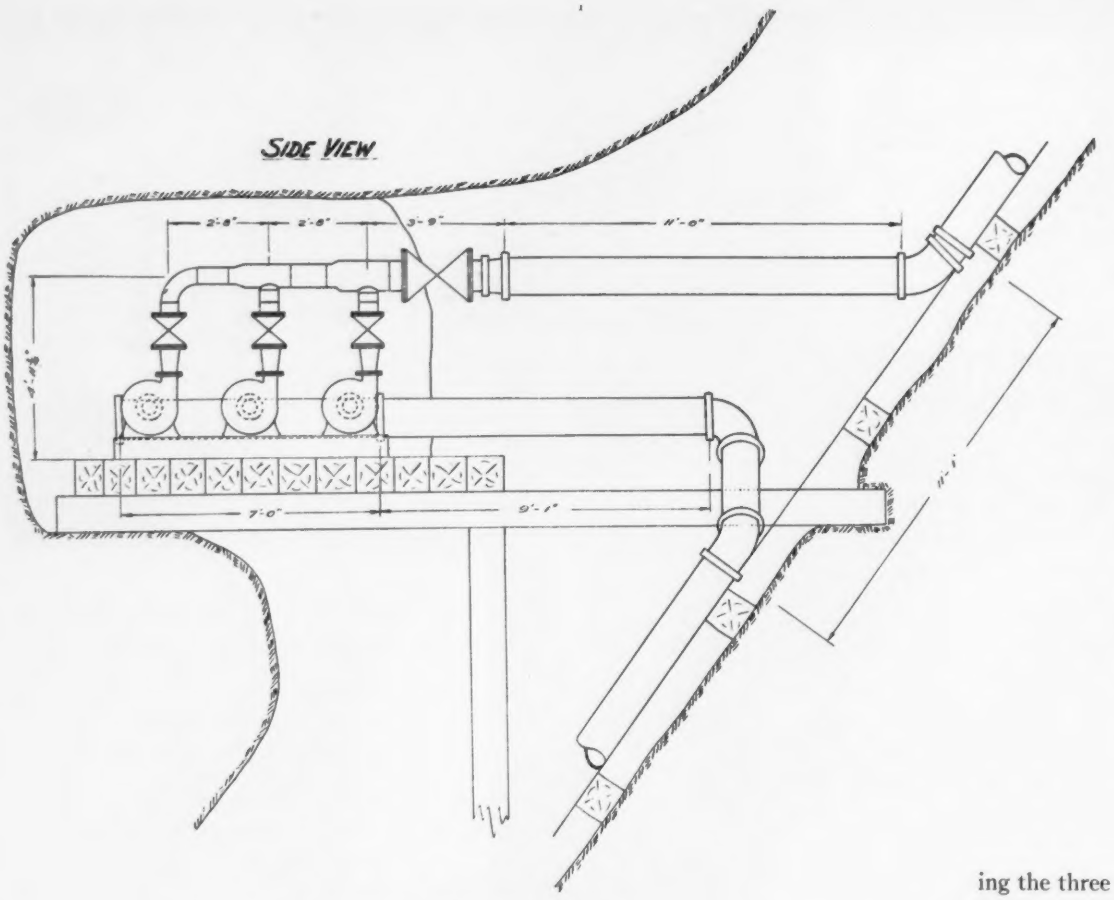
The water column was a 12-inch welded pipe with ⅜-inch walls and was grooved at the ends for Victaulic couplings. The pipe was covered inside and out with a special asphalt coating to protect it from corrosion, and was rated as "protected" pipe. Steel Victaulic couplings were used throughout, and aided materially in the installation and removal of the pipe and provided perfectly tight joints at both the suction and the discharge. That part of the water column that was above the 17th level was bought in 20-foot random lengths: that below that point in 12-foot random lengths. Connections at the pump stations consisted of special lengths, but were standardized as much as possible. In all, nearly a mile of pipe was purchased. The water column was laid in the north-skip road and was supported at 100-foot intervals by heavy clamps and eyebolts anchored to the shaft timbers or to pins set in the footwall.

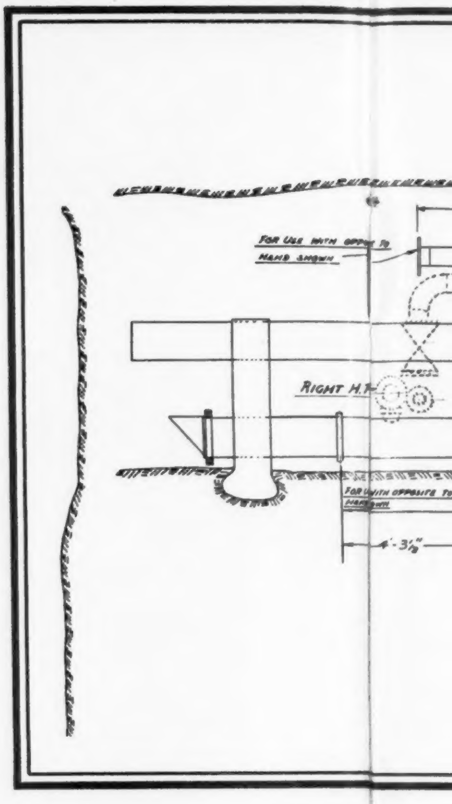
Power for pumping was supplied by the Houghton County Electric Light Company at the special rate of one cent per kw-hr. Three-phase, 60-cycle alternating current was delivered at 2,200 volts, the transformers being placed immediately outside the shaft house. It was carried underground at 2,200 volts in two 3-conductor, armored cables of the submarine type furnished by the American Steel & Wire Company. One line consisted of 300,000 circular-mil cable from the surface to the 23rd level, of No. 4-0 from the 23rd to the 29th level, of No. 1-0 from the 29th to the 31st level, of No. 2 from the 31st to the 33rd level, and of No. 6 from the 33rd to the 35th level. The other line was composed of 300,000 circular-mil cable from the surface to the 5th level, of No. 3-0 from the 5th to the 11th level, and of No. 2 from the 11th to the 17th level. The latter cable supplied power to the station pumps on the 5th, 11th, and 17th levels: the other one served everything below the 17th level.

Eighteen No. 4RVL-30 Motorpumps were used for sinking. They had 440-volt motors running at 1,750 rpm. and necessitated the use of transformers between the main line and the motors. Three of these pumps with drip-proof motors were mounted on a carriage or "float" which traveled on the rails of the north-skip road. Power was supplied to them through a flexible, rubber-covered cable. The pumps on the float could be operated singly, in parallel, or in series. At low head only one pump was required; when the lift had increased to 40 feet, a second pump was started in parallel; and at 80 feet, either three pumps were run in parallel or two in series. Two in series easily handled the water under a 120-foot head. These pumps discharged through 6-inch, 6-ply rubber hoses to a 12-inch manifold with three 5-inch connections at the upper end of the float. The 12-inch discharge manifold was connected directly to the water column by a Victaulic coupling. The suctions were 6-inch standard pipes to the bottoms of which were attached 8-inch standard check valves with strainers.

The float was lowered by a 3-ton chain block fastened to a 1-inch steel cable which was anchored to the shaft timber. Two cables were used to hold the float securely while the block was being moved. When the water had been lowered sufficiently, the discharge was disconnected from the water column, the float was lowered, and another length of pipe was put in the gap. This could usually be done before the accumulated water behind the dams at the pump stations above had been pumped out.

When the sinking pumps were started, the water was 12 feet below the 17th level. When the 18th level was reached, a foundation was built on the plat for three Motorpumps. By the time the water was 20 feet below that level the three pumps were in place and ready to go. The discharge manifold of the pumps on the float was then disconnected from the column pipe and connected to the suction manifold of the pumps on the 18th level, and the discharge manifold of the latter pumps was connected to the column pipe so that they would deliver to the 17th level. The procedure was repeated at the 19th level; but at the 20th a sump was built between two dams into which the pumps on the float discharged. On the 21st and 22nd levels the procedure was the same as that on the 18th and 19th levels; but on the 23rd level there was a big station with three 2-stage pumps, and





LAYOUT OF MOTORPUMPS

Details of the pump arrangement and of the piping on all the levels from the 18th to the 28th, inclusive, except the 23rd, where Class GT pumps were set up. These Motorpumps were all single-stage units operated at 1,750 rpm. by 440-volt motors.

dams were constructed to form a sump. The Motorpumps on the five levels above were then disconnected, and the gaps in the water column were closed so that the pumps on the 23rd level threw directly to the 17th level. Between the 23rd and 29th levels the same procedure was followed, except that only two Motorpumps were placed at each level instead of three, and at the 29th level only two 2-stage pumps were set up. Below the 29th level the amount of water decreased rapidly, and moving took more time than pumping.

Before the mine was shut down in 1932 pumping had been done with high-lift plunger pumps of small capacity in four shafts. These pumps were removed when the mine was closed, but their power lines and column pipes were left in place. Each power line consisted of three strands of rubber-covered wire laid inside piping. Junction boxes were of cast iron. Several of the plunger pumps were put back on their foundations before the unwatering equipment was received, and they served to keep the water below the 17th level. As opportunity arose, more plunger pumps were installed, and soon after the 35th level had been reached the normal inflow could be handled by them and the unwatering pumps could be removed. Wherever galvanized pipes had been used, little trouble was experienced with either pipes or wires, once the wires had been dried out; but where the pipes were not galvanized both pipes and wires were badly corroded and had to be replaced in the majority of cases. In order to check the efficiency of the pumps and to measure the amount of water pumped, a weir was built at the point of discharge on the surface, and a daily log of the output was kept.

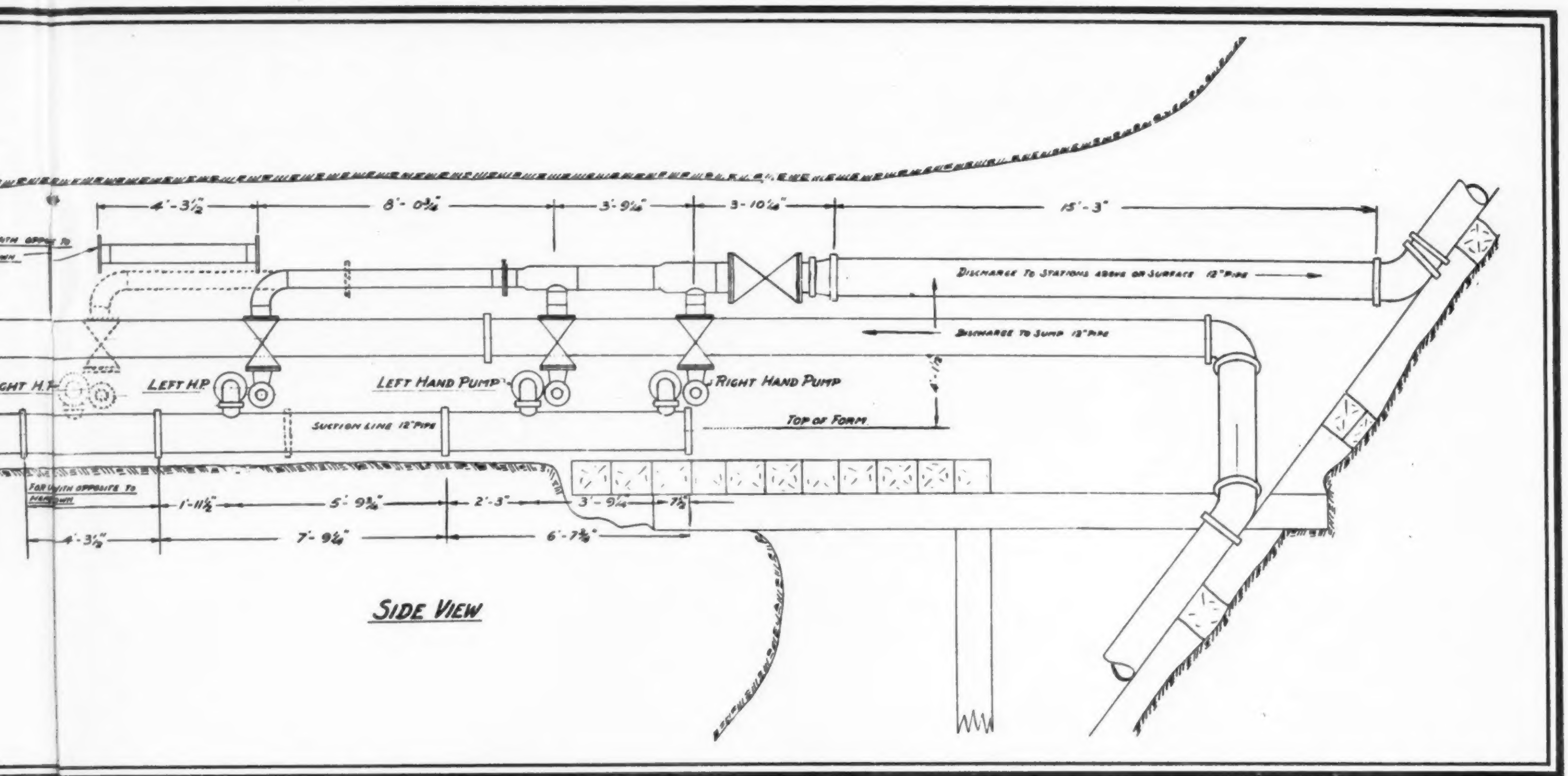
Pumping was begun on August 13, 1937, and the 35th level was reached 292 days later, or on June 1, 1938. The amount of water pumped during this period and during the three months before the centrifugal pumps were started is given in U. S. gallons in the table below.

The center of gravity (average lift) of the water was not far from 2,500 feet vertically below the collar of the shaft, and the average quantity pumped per day was 1,962,000 gallons, or approximately 7,360 tons.

The water left in the bottom levels which were not drained amounts to about 6,000,000 gallons. If we add this to the quantity pumped, the total inflow during the six years and one month that elapsed between the time the mine was closed and the 35th level was reached would seem to be 596,000,000 gallons and the average flow during the same period 215 gpm. To this should be added a small amount representing the water that permeated the wall rocks and that has not yet been drained. The average inflow since the un-

TABLE SHOWING PUMPING BY MONTHS

1937	Centrifugal Pumps 1,000 gals.	Plunger Pumps 1,000 gals.	Total 1,000 gals.	Progress feet
May	—	5,865	5,865	—
June	—	7,230	7,230	—
July	—	4,441	4,441	—
August	47,240	6,150	53,390	115
September	63,343	3,233	66,576	160
October	67,548	4,743	72,291	200
November	72,517	5,200	77,717	188
December	53,061	5,050	58,111	149
1938				
January	38,615	4,890	43,505	126
February	42,208	4,209	46,417	154
March	54,579	4,960	59,539	213
April	54,947	4,525	59,472	311
May	30,645	5,355	36,000	641
Total	524,703	65,851	590,554	2,257



LAYOUT OF GT PUMP STATION

General arrangement of Class GT pumps and piping at one of the four upper stations. Water pumped from below was discharged into a sump, from which it was delivered to the station pumps under a slight head. Because of the reduced size of the lower workings only two pumps were required at each station after the water had reached the 29th level.

watering pumps were stopped, as indicated by the quantity handled by the plunger-type station pumps, has been 225 gpm.

Most of the water gets into the mine near the surface. Some flows in through old stopes and shafts; but the bulk of it comes from the glacial cover over the bedrock. This water seeps down through the crevices and joints in the hanging wall and makes its appearance within 500 feet of the surface. It is slightly alkaline and fairly corrosive, but potable. At greater depth, however, it is very alkaline and corrosive, is unfit for drinking, and attacks both copper and iron freely.

The accumulated water contained a great deal of gas, so much in fact that it was still foamy in the brook a mile from the shaft. What kind of gas it was has not been determined. As a protection against methane, all the men were provided with electric cap lamps, and a coal-miner's lamp was used for testing; but no positive evidence of it was found. The gas bubbles were not inflammable. It has been the assumption that most of the gas was dissolved oxygen and that it was absorbed under high pressure by the water from the dead ends of drifts and stopes. This may account for part of it; but if this had been the main reason for its presence we should have found the greatest quantity in the water on the lower levels where the pressure was highest and where are the largest number of dead ends. That, however, was not the case. Apparently, the top 300 feet of water contained most of the gas. If it had been oxygen absorbed under pressure, there should have been a reduction in the gas content each time the water was discharged into a sump. The reverse was the case. At each succeeding pump station up the shaft the gas content increased and the corrosive action of the water decreased.

The pump bodies suffered only slightly from corrosion, the impeller rings being most affected and the shafts less so. The impeller rings were subjected to what has been miscalled "graphitization" because the resulting product had something of the appearance of graphite. It was in the form of a layer on the outside of the casting, was soft, and could be easily scraped with a knife. However, it was definitely magnetic, and much in excess of the possible carbon content of the iron. It may have been iron carbide from between the grains of which the pure iron had been dissolved. This graphitelike material resisted corrosion but not abrasion, and the parts coated with it developed a natural immunity after the corrosive film of water had been skimmed off. Electrolysis has been blamed for the corrosion; but there was no direct-current electricity in the mine. Tests indicated that the electrolytic value of the water varied from 40 to 100 millivolts and that the alkalinity pH value varied from 6.4 to 7.3.

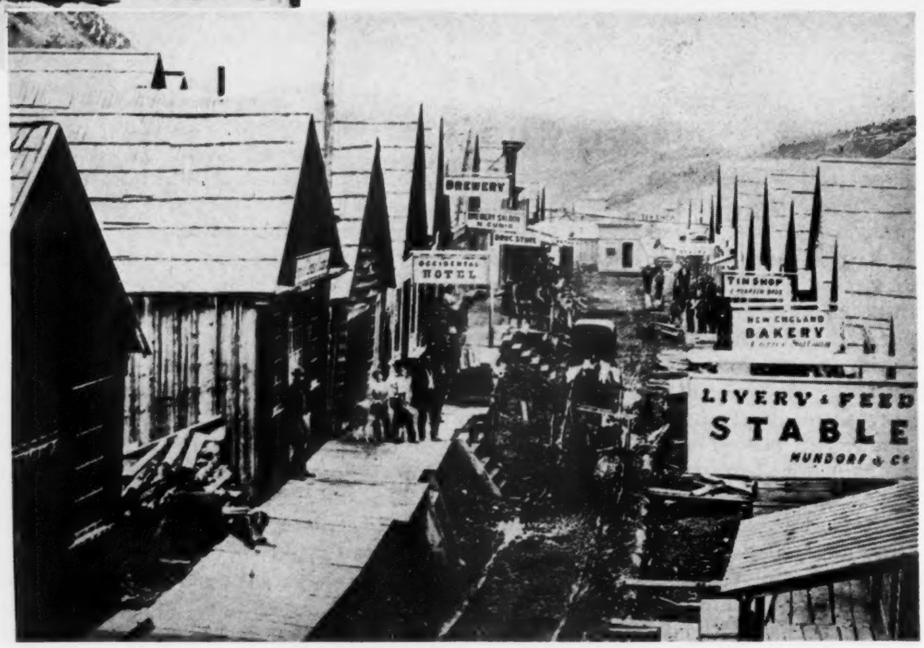
On the other hand, trouble with electric equipment increased with depth and with an apparent increase in alkalinity. The water contained both magnesium chloride and calcium chloride, both of which are carried in the damp air and were deposited on the coils of the motors. As both salts are deliquescent, it was only a question of time before the insulation was ruined. Changes in insulation and in the direction of flow of the air currents in the motors resulted in improvement; but on a large job of this kind it would, apparently, be the part of economy to use completely enclosed motors.

In the upper part of the workings that were underwater, corrosion of pipes, rails, bolts, nails, etc., was heavy except in the case of galvanized material: in the lower levels, which had been underwater the longest, it was much less pronounced. At the dead end of one drift the confined air had held the water back to such an extent that the floor remained dry, and rails and tools that had been left there showed little signs of corrosion.

The choice of equipment and the design of the pump stations were for the most part the work of W. H. Schacht, general manager of the Copper Range Company, and of his assistants, B. W. Manderfield, chief engineer, and M. G. Myers, electrical engineer. A. G. Andrew, Jr., superintendent, was in direct charge of operations, and was ably assisted by Capt. W. Skewes and by James H. Richards, master mechanic. It is to the untiring efforts of these men and of the rest of the staff that the success of the undertaking can be largely attributed.

Gold Mining in British Columbia

R. C. Rowe



BARKERVILLE—PAST AND PRESENT

The principal camp of the Cariboo gold field, scene of British Columbia's greatest gold rush. The lower picture was taken in 1868, six years after the town was founded by William Barker. At the upper left is a recent view of the main street. The first structure on the left is the Kelly Hotel, built in 1869.

II

Placer Mining

IN 1860, gold was discovered at the junction of the Fraser and Quesnel rivers, and more than 600 men were soon engaged in washing gravel at that place. It was during the open season of the same year that some men penetrated to Antler Creek, which eventually proved to be one of the world's great placer fields. These men undoubtedly worked up the Quesnel, dipping their pans here and there and finding that same trail of fine gold that had lured them up the Fraser, led them to the Quesnel diggings, and continued to lead them on. But as they ascended the Quesnel the trail became more and more tenuous until their questing pans returned them only the merest traces. Something was evidently wrong with the theory of the origin of gold that had brought them so far. Finally they moved over the divide and discovered Antler Creek—and the trail grew strong again. During 1860 some work was done; but the production is not recorded.

The pioneers of Antler Creek found themselves in a country that was broken by innumerable streams and valleys; and there was gold in every gulch feeding the main creek. Encouraged, they toiled feverishly and spread out over the surrounding terrain; but the real riches of the Cariboo eluded them that year. Meanwhile, of course, news was filtering out, and a very definite movement into the area ensued. By the spring of 1861 this had developed into what was almost a gold rush.

Most of the men who swarmed into the region have been forgotten long since; but there are a few whose names are still remembered. Among these was a German, William Dietz, commonly known to his intimates as "Dutch Bill." His only claim to immortality lies in the fact that one day he looked down on an unknown creek which he had come upon during what was, without the slightest doubt, a completely blind traverse. He traveled down the ridge, and in a pan of gravel found high values. "Dutch Bill" did not know it, but he had stumbled upon Williams Creek, the richest

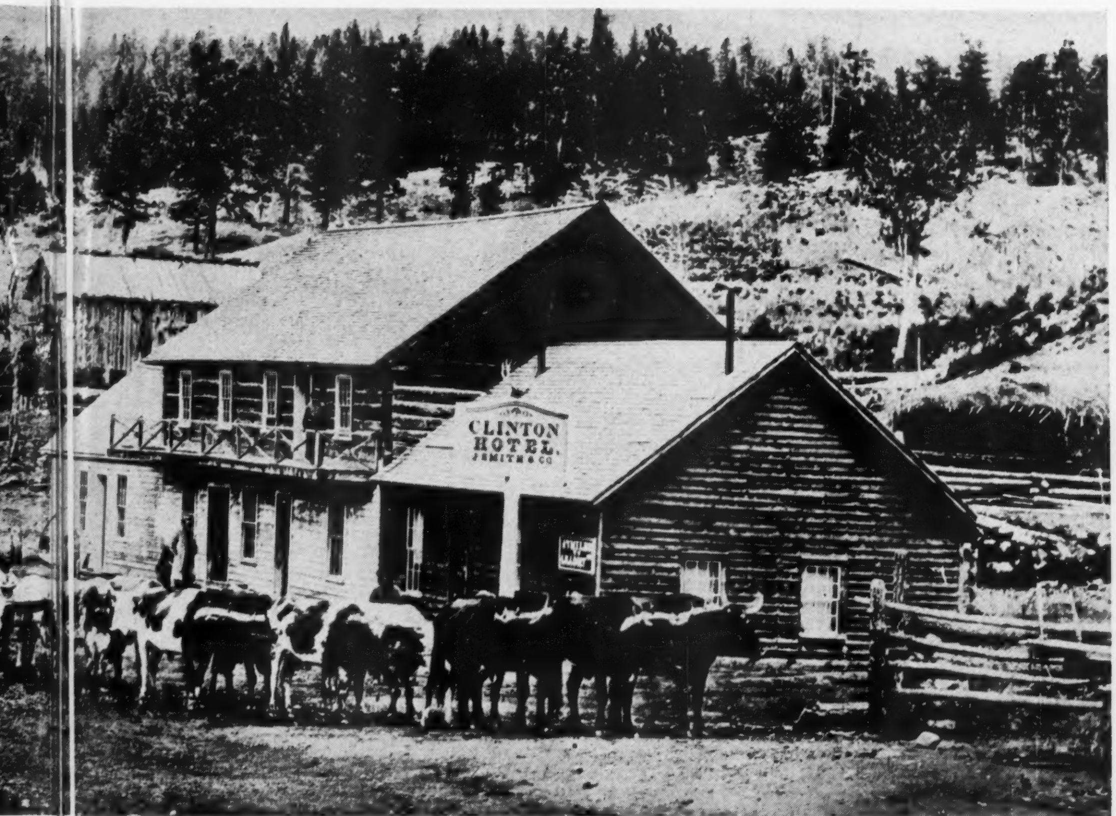


Photo from Geological Survey of Canada

CLINTON, BRITISH COLUMBIA, IN 1868

An ox-drawn, covered-wagon train at one of the stopping places on the road to Cariboo in 1868. The construction of this highway over difficult terrain was a notable achievement of the Royal Engineers. Prior to its opening, the only route to the placer workings was over the perilous Fraser River Trail. Everything people used had to be borne on the backs of horses and men, and prices were consequently sky-high. A letter written in 1858 by J. W. Adams, superintendent of the trail, records that flour was selling at $44 a hundred pounds, sugar at 60 cents a pound, bacon at $1 a pound, and beans at 50 cents a pound.

SUNSET, THOMPSON RIVER

It probably looked much the same when the early gold seekers first saw it.

gold-bearing stream ever discovered in the Province of British Columbia.

Being a man of proper qualities, "Dutch Bill" returned to his headquarters and told his partners of his find, whereupon the party returned to the creek and staked their claims. Being in a hurry, which is not to be wondered at considering all the circumstances, they did not examine the ground very carefully and therefore missed the old bed of the stream where the great riches of Williams Creek were eventually discovered. As a consequence, their claims were not particularly profitable.

There is a story to the effect that the partners of Dietz insisted that he name the stream to which he had led them and that "Dutch Bill," perhaps dimly craving immortality, suggested that it be called "Billy Creek" after him. His partners, however, entertained some doubts as to whether such an appellation bestowed a proper amount of dignity upon so important a stream, and it was at their earnest behest that Dietz consented to the name of Williams Creek. This may or may not be true; but, one way or the other, Williams Creek did not quickly enter into the full glory of its name. As a matter of fact, it became buried in ignominy and was known to all and sundry as Humbug Creek because the early work there completely belied the promise of the first discoveries. It was not until midsummer that the first real strikes were reported which made the stream world famous.

From then on the Cariboo District flashed across the pages of mining history like a comet across the summer sky—and British Columbia entered its second great gold rush, and perhaps its greatest. Men flocked to the Cariboo from the ends of the earth, lured by the prospect of gold they came, from the merest city tenderfoot to the hard-bitten adventurer. In 1862 William Barker staked the claim upon which Barkerville was founded. Barkerville became one of the picturesque pioneer towns of the world, and its story glows with color, intermixed with the usual amount of tinsel and tragedy. Barkerville, however, was far from anywhere, and the camp with its diggings required all the gear and accessories that men need to work and to live. This, in its turn, constituted as pretty a transportation problem as could be imagined.

The trail along the Fraser Canyon, through the heavy woods, and alongside the lower-lying streams was almost impassable. The traveling of it called for qualities of endurance and strength that were almost superhuman, and, as a result, mortality among the men and animals was high. Pack horses were largely used for the transportation of goods; and it is easy to imagine to what height commodity prices soared in Barkerville. Vehicles, of course, would not do. As a consequence, all manner of ingenious devices were pressed into service to overcome the natural difficulties, and some particularly progressive souls even tried camels, which, as a spectacle of incongruity, must have had a quality all their own.

The obvious importance of the new gold fields rendered the construction of a road into the Cariboo absolutely necessary. The factor of common humanity entered into the matter—in addition to the appreciation of law and order that was growing fast in the Colony of British Columbia even though it was very new. British Columbia was no longer a shadowy outpost of empire: it was a Crown Colony with British law and order as the core of its being and personified by a hanging judge, together with a company of Royal Engineers under the charge of the redoubtable Colonel Moody.

It was to the latter that the job of constructing the road was entrusted; and with that nicety of execution and decisiveness of action which has characterized the work of the Royal Engineers from one end of the world to the other, they did it without fuss or feather. The roadway was completed in

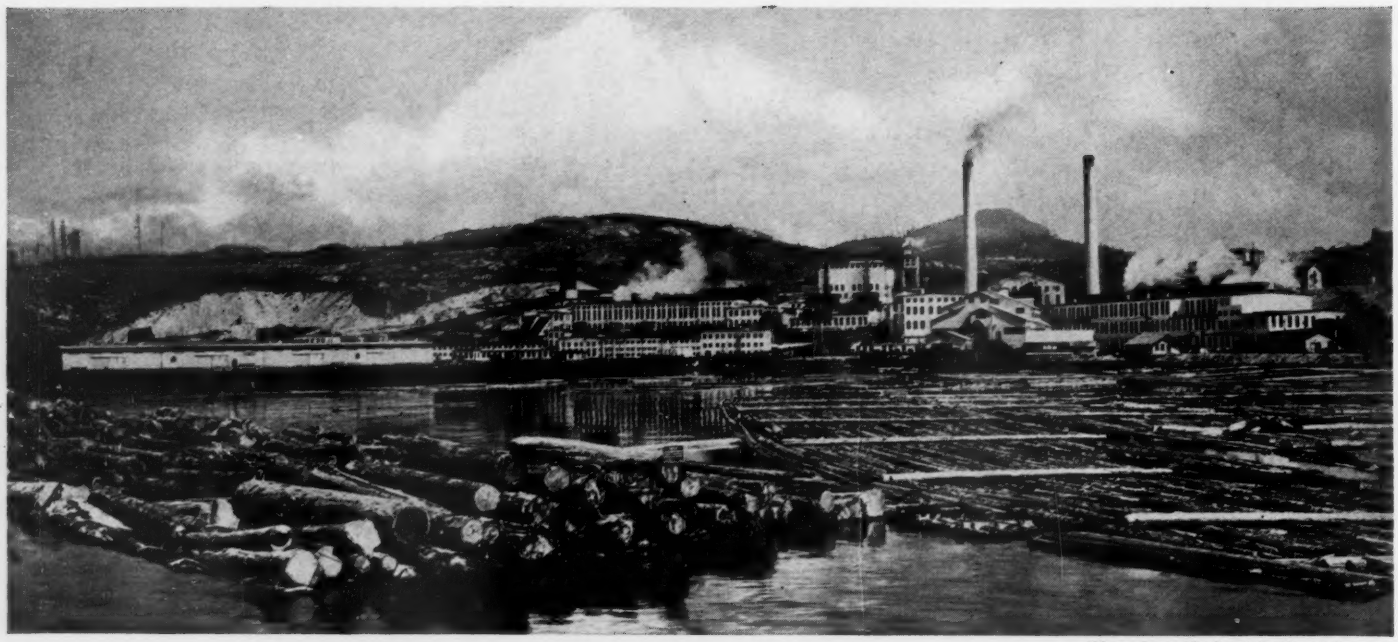


Photo from National Parks of Canada

A BRITISH COLUMBIA PAPER MILL

Natural resources are the foundation of most of British Columbia's industries, among which the making of pulp and paper is prominent. This plant is on the Powell River. Fishing is second in importance among the province's industries.

1865, which is more than 70 years ago, and it still stands. No matter how you look at it, it was a terrific piece of work that Her Majesty's Royal Engineers undertook. They had to hang sections of the road on the sides of precipitous Fraser Canyon; they had to carve a way through heavily wooded and tangled country; they had to make a foundation to build upon in swamps where the quaking live mud seemed to go clear down to the bowels of the earth; they had to bridge streams and to circumvent the impassable. They did it all, and in 1865 you could travel in the luxury of a coach to Barkerville; and there is not the slightest doubt that sundry gentlemen over long pipes and drinks nodded wisely and spoke sagely of the strides of progress, just as they do now.

It is reasonable to suppose that many a man of that period was rather scornful and spoke proudly of "the old days" when you didn't ride in comfort to Barkerville. One can easily hear in fancy the half wistful accounts of the hardships of the early Cariboo Trail, its humors and its tragedies. We can hear almost the same stories, told in the same voices, of trails that have vanished in our times. Get a few men together who know the North and listen to their talk of getting into Porcupine or Rouyn before the railway came, and the essence of their descriptions will differ only in detail from the words of those who spoke about the old Cariboo Trail more than 70 years ago.

SMALL HYDRAULIC PLACER

Monitors sluicing down the gravel in Walker's Gulch, a tributary of the famous Williams Creek where "Dutch Bill" Dietz made the discovery that precipitated the greatest rush of gold seekers British Columbia has ever known.

Through them all—the stories of yesterday and today—runs a thread of regret for the lack of accomplishment and the passing of the strength of youth and maturity. Men tell of the hardships of old trails because the tales reflect their endurance in overcoming the difficulties they met; they tell of the humor because in it is buried their own lusty love of life; and they tell of the danger because it mirrors their own intrepidity. The events of the past take on glamour almost in exact proportion to the distance they recede from the present, and time or age cannot change that fact.

All of which, though somewhat aside from the point, is nevertheless definitely related to the new road, which soon presented a scene of feverish activity. Upon it streamed as varied a mass of humanity as ever could be imagined. Long trains of ox teams lurched along dragging great wagon loads of supplies; and it is safe to assume that many a weary pioneer rode with them. There were stagecoaches for those who traveled with money; and there must have been a motley array of other vehicles. Lastly, there were the hosts of men on foot with packs on their backs or pushing the 2-wheeled barrows which became characteristic of the Cariboo Trail.

Meanwhile the Cariboo creeks were startling the world. The names Williams, Lightening, Antler, and Lowhee became known far and wide. It is estimated that in excess of $2,000,000 worth of gold was extracted by about 1,500 men in 1861. Two years later the district attained its greatest production amounting to more than $3,000,000, and a high level was maintained for some time thereafter. The exact value

of the yield from the Cariboo placers is unknown; but various estimates place it at from $25,000,000 to $40,000,000, with $35,000,000 as the most probable total.

Naturally, the Cariboo, like all placer districts, rapidly reached its peak and then started on the long road of inevitable decline. It passed through its first flush of productivity when men reaped the gold harvest of Nature's ages of slow accumulation, when fortunes were made quickly and there was little thought of tomorrow. But those days went by as they always must, and leaner times came. The decline was slow: in fact, through the long years the Cariboo really has never died and is today still a gold producer. Its later activities, however, rightfully concern lode mining, with which we shall deal subsequently in this review.

But before leaving the Cariboo for the present, it is proper to glance for a moment at the place it occupies in the history of British Columbia. There is no doubt that because of the discovery of the Cariboo gold fields the development of British Columbia was begun years earlier than it otherwise would have been, for without that stimulus the growth of the province would have proceeded along the orderly lines of gradual expansion. It was the lure of gold and the outpouring of a substantial amount of wealth that attracted to it numbers of that type of man that is best suited to push forward the social and economic development of pioneer lands.

As a result, British Columbia expanded rapidly, and the attention focused on its gold possibilities threw into sharp relief its other resources. Many of those that came to mine gold turned to other things, all of which reacted to the betterment of the province. As was to be expected under the circumstances, the Cariboo filled an army of men with dreams. Those that came late and found the creeks staked solid, compensated their disappointments with the thoughts that there must be other Cariboos, and so they naturally started out to look for them. They did not discover a new Cariboo in British Columbia: there probably isn't one, because ever since 1860 men have quested fruitlessly amid its eternal hills and mountains and wandered up its countless streams. If there is a second Cariboo, it has eluded them. They did, however, as we have said before, find other placer districts which have all added their share to the output of alluvial gold.

Edwin Galloway Photo

VANCOUVER AT NIGHT

The rapidity with which British Columbia has been developed—it is only 80 years old—is attributable in large measure to the gold discoveries that attracted hordes of men, with the pioneering instinct, who quickly penetrated to the farthest borders of the province. Although it was founded little more than half a century ago, Vancouver is today a metropolitan city in every respect. The larger part of the fisheries of British Columbia are near Vancouver, the principal catches being salmon, herring, and halibut. Lumbering is also a leading industry of the area.

CLEANING BEDROCK

Fine gold is often entrapped in crevices and has to be dug out.

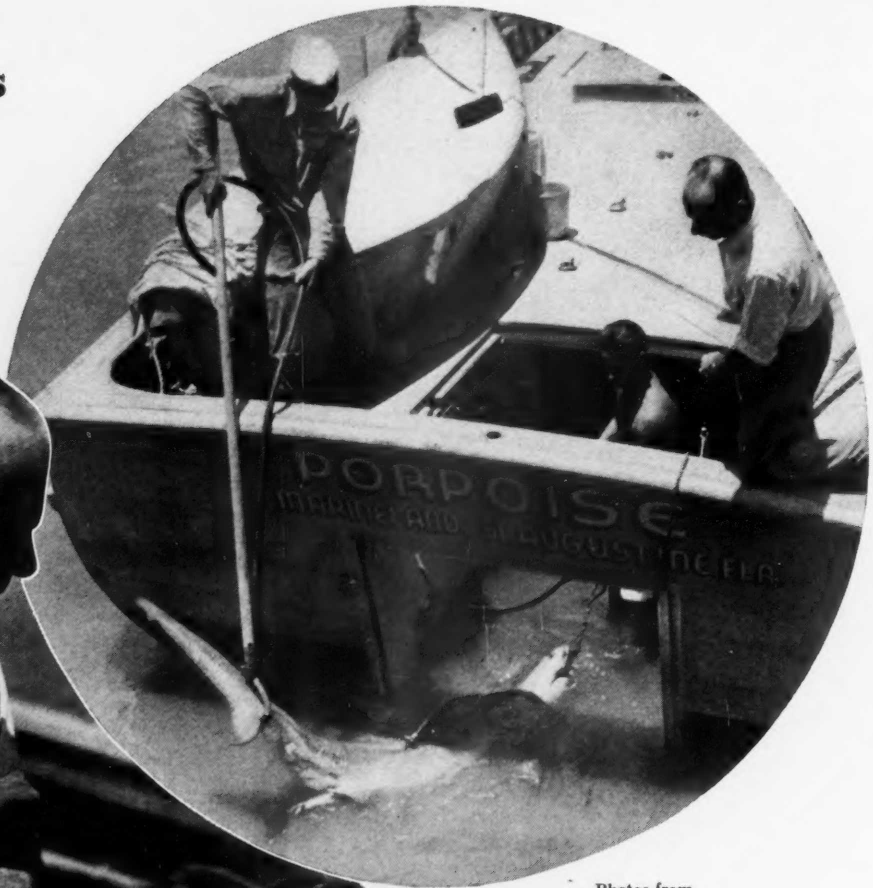
In 1865 the Kootenay was discovered; in 1866, Big Bend; in 1869, Omineca; and in the early seventies the Cassiar. Gold was struck in Dease and Thibert creeks in the Cassiar District during 1873, and MacDame Creek yielded up its golden secret in 1874. All these created much excitement and have produced a great deal of gold. Each and all, together with a host of other streams large and small, have contributed to the progress of the years. Their material contribution can be measured in money, nearly $90,000,000 of it at the statutory price of gold; but the more indirect contribution, which belongs to the realm of the immaterial, can never be gauged or translated into human values. The placers of British Columbia were directly responsible for the birth of lode mining in the province: they have served as indicators in the search for gold in place. But, what is perhaps more important than either, they provided the great incentive for the early exploration of the province.

Ontario, after a couple of hundred years of settlement, knew very little about its northern hinterland. British Columbia, on the other hand, knew a great deal about its great outer lands before it was settled. After all, British Columbia is not yet 80 years old, and when one travels through it, and finally winds up in such cities as Vancouver and Victoria, one realizes what has been achieved. In fact, the writer has a conviction that the rate of development of British Columbia and the results obtained there are almost unique. All this has not come about accidentally. There is not the slightest doubt that the terrific impetus supplied by early placer-gold discoveries has been one of the great driving forces in the progress of less than eight decades. It is still a force, for in 1936 some 33 divisions reported production of placer gold.

This is the second of a series of articles by Mr. Rowe. The third will appear in January.

Huge Aquariums for Marine Life

G. H. Dacy



Photos from Marine Studios

TAKING A SHARK ALIVE

A specially constructed boat, the "Porpoise," has a well built in its stern in which captive creatures are transported to the aquariums. To permit their capture without injury, they are anaesthetized with a harpoon, which is shown in the hands of its inventor, Count Ilia Tolstoy. With his right hand he is demonstrating the removal of a rod from its socket, which action releases a charge of compressed air that serves to inject the drug through the hollow harpoon "needle." A small shark that has been rendered unconscious in this manner is pictured as it is being maneuvered into the well of the "Porpoise."

TWO huge aquariums, reputed to be the largest in existence, have been constructed at Marineland, 18 miles south of St. Augustine, Fla. Their purpose is not only to exhibit to the general public creatures that dwell in the sea and that cannot be held in captivity in smaller enclosures but also to permit scientists to study them. To serve these ends, the aquariums have been provided with special facilities for both visual and photographic observation of the specimens.

One of the tanks is circular, 75 feet in diameter and 11 feet deep. The other is polygonal in plan, 100 feet long, 40 feet wide, and has a maximum depth of 18 feet. The two are connected by a steel flume. Both enclosures are suspended—that is, they are elevated above the ground level; and transparent portholes at various heights provide views of the interiors from many angles. Through these, motion pictures are expected to be made that will record the behavior of many denizens of the deep in surroundings that closely simulate their natural habitat.

The construction of the aquariums entailed many problems in design. It was first planned to build them of massive concrete; but it was found that this would have necessitated walls 12 inches thick, supported on strong foundations, resulting in too great a weight. To circumvent this objection, the tanks were formed by welding together plates of steel ½ inch thick. The interiors were lined with Gunite, which was applied in the usual manner with compressed-air guns against a steel-mesh reinforcement set ½ inch away from the surface of the plates. The coating is 1¾ inches thick, making the total wall thickness only 2¼ inches. Aside from strengthening the tanks, this lining also acts as an insulating agency and aids in regulatng the temperature of the water. The construction of the tanks proper, together with their foundations, involved the use of 304 tons of steel and 5,000 tons of concrete, as well as 300 barrels of cement and 131 cubic yards of sand for the Gunite.

The aquariums front on the Atlantic Ocean, from which their water supply is obtained by pumping. Investigations revealed that it would be impossible to duplicate in a synthetic liquid the delicate chemical balance of ocean water. When filled, the tanks contain some 784,000 gallons of water, which weighs 3,271 tons. Their contents are changed more than six times every 24 hours, and this entails the pumping within that period of more than 5,000,000 gallons. The pumping capacity is 3,600 gpm. The inlets are located 18 inches below the normal water level, and the incoming streams create a surficial rotary motion that keeps the temperature within the enclosures uniform.

There are 200 portholes for observation and photographing located at four different

levels. These consist of Tuf-flex—high-strength plate glass—⅝-inch thick, and are made watertight with rubber gaskets. The shapes of the aquariums are such as to permit filming the specimens from every possible angle, even from below. As authorities on marine life are unable to predict just how well the different species will get along together, coral gardens have been provided in the bottoms of the tanks to serve as refuges for the smaller denizens in case they require them. All adaptable aquatic creatures are to be placed in the pools, and these may possibly include the barracuda, the "tiger fish" of the sea. Lively action is expected at times when various forms of fishes and mammals are brought together. Among the first of the exhibits were a mother porpoise, weighing 850 pounds, and her 125-pound youngster, offering scientists an opportunity to view clearly from the side the porpoise's peculiar galloping form of locomotion.

Arthur McBride, curator at Marineland, explains the purpose of the enterprise as an effort to give the spectator a dramatic, vivid, and fascinating cross section of life in the sea, where the struggle for existence is even more violent than it is on land. Inasmuch as most aquariums have ignored the invertebrate forms of ocean dwellers, special attention are to be given to them.

"It is impossible at this time even to guess how many species can be brought together in our tanks," states Mr. McBride. "The limiting factors can be established only through experience. For the sake of those who are primarily interested in the higher and more active forms, we will make particular efforts to capture the very large fish."

It is obvious that the capture and preservation of live fish weighing up to 2,000 pounds, and perhaps even more, are fraught with numerous difficulties. To overcome these obstacles, special equipment has been provided. This includes a diesel-engine-driven boat with a cruising radius of 1,000 miles. This vessel, named *Porpoise*, is 48 feet long, 16 feet wide, and draws 44 inches of water. A large watertight metal well in the stern opens directly into the sea through a trap door. Through this well a steel cylinder, 17¼ feet long, can be lowered into the ocean. This serves as a safety cell in which a shark or other big specimen may be transported from the point of its taking to the aquariums.

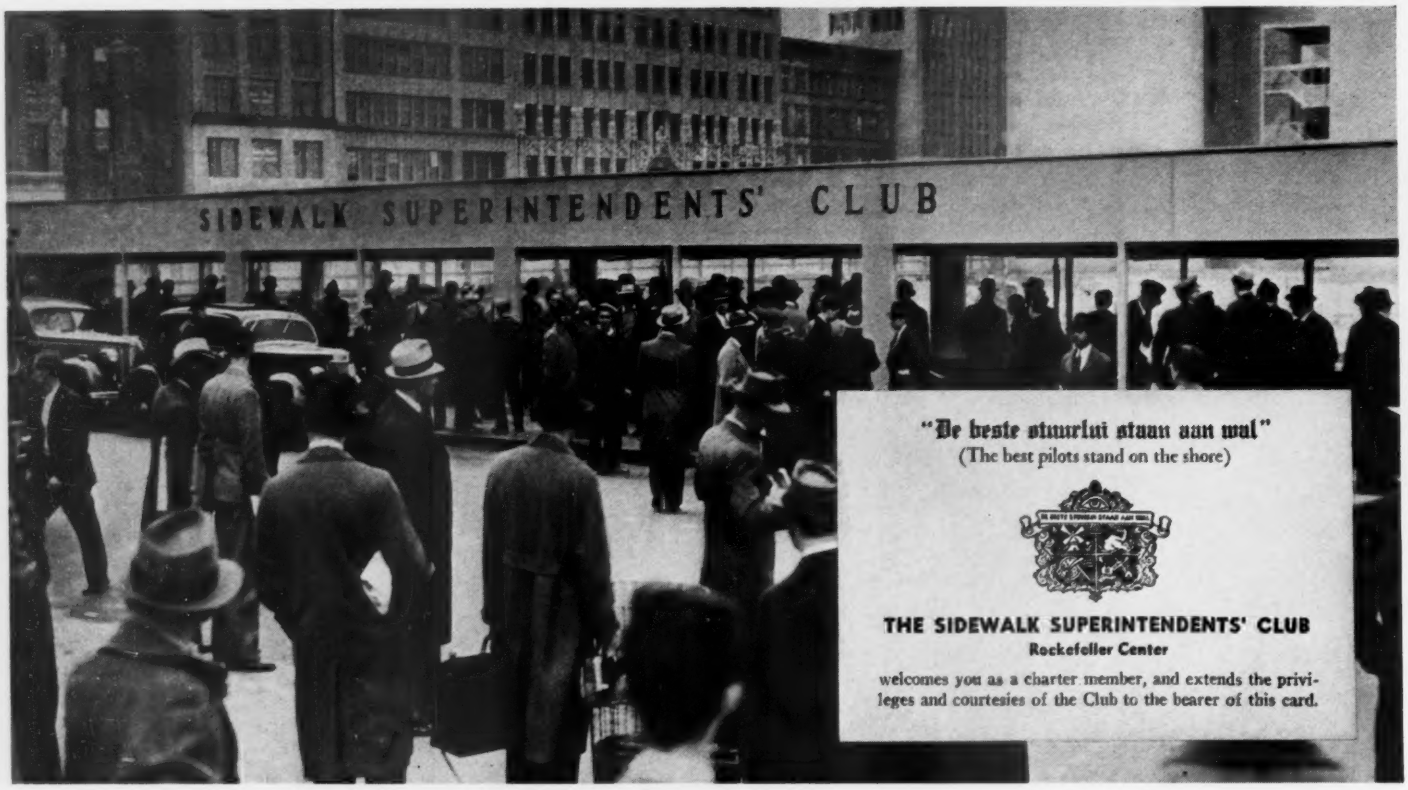
The problem of how sharks and other savage monsters might be subdued without injuring them engaged the attention of various authorities. Dr. G. Kingsley Noble of the American Museum of Natural History conceived the idea of anaesthetizing them, and after experimenting with sixteen drugs found one that would knock out a large shark in 60 seconds. When injected in the dorsal region it renders a shark passive for about 2½ hours, after which it returns to normal, with no "hang-over" or other harmful effect.

For administering the drug, Count Ilia Tolstoy, grandson of Leo Tolstoy, the famous Russian novelist, devised a special harpoon, which is essentially a large hypodermic needle mounted on the end of a pole. After a fish has been harpooned, it is possible to release a charge of compressed air from a bulb. This air passes through a rubber hose leading to the needle and serves to inject the drug.

While the shark or other captive is unconscious, and floating bellyside up in the water, the crew of the *Porpoise* carefully maneuvers it into the steel cylinder, or directly into the well of the boat. If the former is used, it, together with its cargo, is drawn up through the trap door into the well, after which the craft returns to the aquarium to deliver its prize. If the confined creature shows signs of animation before its destination is reached, a second but smaller dose of the drug is administered. Newspapers recently told of the successful use of the hypodermic harpoon in the capture of a 7-foot ground shark.

GENERAL VIEW

These connected aquariums, or oceanariums, are in reality small sectors of the sea itself, as water from the nearby Atlantic Ocean is continually circulated through them. Built above the ground level, their walls contain 200 glazed portholes through which captured marine specimens may be studied and photographed.



DEDICATED TO DAWDLERS

A gift from John D. Rockefeller, Jr., to the myriad curious persons who can't get by an excavation site without stopping for a while. The gallery overlooks a sizable hole quarried out for planting the roots of a 16-story building in Rockefeller Center, New York City. At the right is shown the charter membership card that was given all visitors during the opening week. At the top of the crest is the all-seeing eye. The windmill and tulip in the upper left-hand division are Dutch symbols, and the ground hog at their right suggests digging. The power shovel is self-explanatory, while the clock face being struck by a hammer conveys the idea of killing time.

Gapers' Gallery for "Sidewalk" Excavators

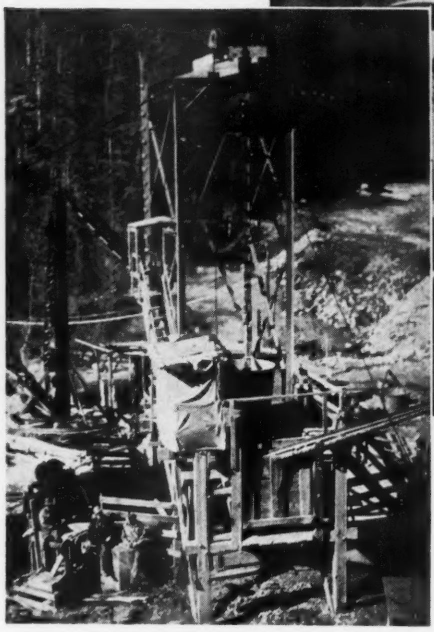
BEING what they are, most human beings simply cannot resist pausing at a building-excavation site to watch the rock drillers, power-shovel operators, and truck drivers. Even busy men who rush around their own offices in a frenzy of getting things done, seem to forget about fleeting time when they chance upon a construction drama. Some men who are not so busy become experts at just watching other fellows work.

Construction men jestingly call these onlookers "sidewalk superintendents," an apt name in view of their readiness to express their own opinions as to how the operations should be conducted. Carrying out an idea that originated in Hollywood, Calif., and that was also put into effect in Des Moines, Iowa, New York City has given these volunteer builders special recognition. In Rockefeller Center, bordering a plot of ground on which there will soon rise a 16-story building, an attractive, covered gallery 100 feet long has been erected to provide an unobstructed view of the excavation work. Emblazoned on the side facing the street are the words, "Sidewalk Superintendents' Club."

George J. Atwell, head of the well-known New York firm that is doing the excavating, has been made honorary president of the club. With all the pomp and ceremony that usually attend a cornerstone-laying, Mr. Atwell, on November 10, formally opened the inspection gallery by cutting a satin ribbon stretched across one of the entrances. A uniformed attendant is on duty in this glorified booth during the hours the subterranean show is in progress, and he courteously answers questions on matters that may be puzzling those who pause. During the first week after the shelter was established, he handed out charter membership cards to the club to all visitors. One of these cards is reproduced on this page.

At either end of the gallery are semicircular rotundas where watchers may stand and look into the excavation to their hearts' content without being jostled by those who are merely passing through. On each rotunda there is mounted a large coat of arms bearing the Dutch motto, *De beste stuurlui staan aan wal*—"The best pilots stand on the shore." It is an old proverb that is doubly appropriate, inasmuch as the building to be reared there will be the Holland House—Dutch commercial headquarters in New York. The same crest and motto appear on the membership cards. What is more, there is a box into which the curbstone building experts may drop suggestions or complaints; and it is reported that they are making liberal use of it.

The gallery was erected by Rockefeller Center, Inc., and we have it on the authority of that organization's public-relations office that it was created at the instance of no less a personage than John D. Rockefeller, Jr. According to the story, Mr. Rockefeller himself is a confirmed watcher of excavating operations, and it has long been his habit to slip out of his office now and then and travel incognito about the subsurface diggings that are perennially underway in the vast building development that he inaugurated. One day he had just succeeded in edging himself into a particularly favorable vantage point at the opening entrance to a trucking ramp when a watchman admonished him to "Keep moving, Buddy!" Mr. Rockefeller obeyed, but the experience set him thinking. Perhaps he heard about the Hollywood innovation, where the National Broadcasting Company had windows put in the fence surrounding the excavation for its new studio so that the public could look in on the proceedings. In any event, he kept on thinking, and one day he announced the idea of the "Sidewalk Superintendents' Club." It has been so successful that other New York builders are likely to follow his example.



CONSTRUCTION SCENES

A general view of the headframe; a group of workmen about to descend in a bucket; and the Motorcompressor that supplied part of the air used on the job.

William S. Powell

Speedy Sinking of Large Air Shaft

A NEW air shaft for ventilating purposes has just been completed 4 miles from the opening of the Carswell Mine of the Koppers Coal Company on Laurel Creek, about 5 miles from Kimball, W. Va. The work was done under contract by the R. G. Johnson Company of Washington, Pa. The shaft is 562 feet deep and oval in section, with maximum dimensions of 16x32 feet inside a concrete lining 12 inches thick. It extends 13 feet below the three entries into which it opens at the bottom, and that lower portion is to serve as a sump. Work was begun on April 30, 1938, and the opening connecting the entries was cut through on November 1.

Preparatory to the beginning of actual construction, The Mott Core Drilling Company of Huntington, W. Va., drilled thirteen grout holes in the proposed area of the shaft to seal off ground water and thus to insure a dry working place. The first hole was drilled in the center to a depth of approximately 500 feet. Only four holes had to be drilled to the ultimate shaft depth, the others varying from 80 to 300 feet. More than 17,000 bags of cement were used for the grouting operation. Test holes put down in the vicinity revealed for the most part white and dark sandstones, dark sandy shale, and a little sandy fire clay. Five or six seams of coal, about 1 foot in thickness, were penetrated at various depths.

After the grouting operations had been completed, actual excavating was begun. The Walton Sudduth Construction Company of Bluefield, W. Va., excavated the first 10 feet of the shaft by means of power shovels. This carried the work down to solid rock, which persisted throughout the work. Approximately 11,000 cubic yards of material was removed. Drilling was done with six Ingersoll-Rand JA-55 wet Jackhamers using 1-inch hexagon Jackrods in lengths up to 12 feet. Jackbits from $2\frac{3}{8}$ to $1\frac{1}{2}$ inches in size were utilized and reground by a J2 Jackbit grinder. Drill rods were rethreaded with a Toledo hand threading tool. The contractor's superintendent estimated that between 198 and 212 Jackbits were used every 24 hours, during which period one round of drilling was completed in the very abrasive material that was encountered. A typical drill round consisted of approximately 100 holes. These were drilled to an average depth of 6 feet and loaded with 40 per cent gelatine dynamite. Air for the drills was furnished by three compressors: two Class ER-1 units of 10-inch stroke and a Type 40 air-cooled, 2-stage 50M Motorcompressor.

The muck was removed in a $1\frac{3}{4}$-cubic-yard bucket which was handled by a hoist. The crew consisted of thirteen muckers, a shaft boss, and five men on the surface. About 135 buckets of material were taken out during an 8-hour shift. The spoil was loaded in trucks and hauled several hundred feet away to a dump. The sandstone was later crushed by equipment installed on the job and used as aggregate for the concrete lining. Limestone sand for the concrete was provided by the Pounding Mill Quarries at Pounding Mill, Va. The contractor operated a small Butler batcher plant stationed at the top of the shaft. The sand and gravel were placed in the bins by means of a small clamshell bucket on a boom operated by an electric hoist.

The concrete was dumped from the batcher into a 1-cubic-yard Koehring mixer and thence into a bucket for lowering into the shaft, which was lined as the work progressed downward. After a vertical section of 39 feet 9 inches of material had been taken out, forms were set up and the concrete poured. This sequence of operations was repeated until the bottom of the shaft was reached.

Alpha and Lawrence portland cement were used for the lining and will also be used in the mortar for a 12-inch curtain wall that is to be constructed of brick. Upon completion of the shaft an exhaust fan will be installed on one side of the curtain wall while the opening on the other side of the wall and additional surface openings will serve to bring in a supply of fresh air

More than 70 men were employed on the job, working in three 8-hour shifts six days a week. Electric power was furnished by the Koppers Coal Company. The shaft was completed without a serious accident. The undertaking was in charge of F. G. L. Cox, division superintendent of the Koppers Coal Company, with headquarters at Kimball, and Tom Booth was the engineer for the coal company. The personnel of the construction company includes R. G. Johnson, president; C. H. Dorsey, general manager; Charles Steenburgh, superintendent; and S. C. Johnson, engineer.

PRODUCTION OF DIAMONDS

NEXT to gold, diamonds, of all the natural products, probably have the greatest allure for the human race. Yet, because they have been discovered in relatively few parts of the globe, and because their exploitation is closely controlled, comparatively little is published regarding their production. Writing in *Jewellers' Circular-Keystone*, Sydney H. Ball reports the 1937 world output to be 9,003,302 carats worth, at the mines, some $43,474,750. The low indicated value of less than $5 a carat is explained by two facts: first, less than one-third of the stones were of gem quality; and, second, a great deal of the ultimate value of gem stones is imparted to them by the cutting process.

Ninety-five per cent of the 1937 production came from Africa, and the remainder from South America. For the first time in eight years the Belgian Congo lost its place as leading producer, having been supplanted by the Union of South Africa. Together, they accounted for 59 per cent of the world output. It is significant that diamond mining still is preponderantly the work of unskilled labor. The largest individual producer, Beceka, employs in its Belgian Congo operations 28 Europeans and 4,970 natives. Virtually all diamonds now come from alluvial deposits. Considerable mechanical equipment is used in Africa to facilitate the segregation of the valuable stones from the gravel; but in British Guiana the primitive process of washing the gravel in wide, shallow pans, known as *bateas*, is largely relied upon.

Inasmuch as two-thirds of the diamonds recovered are of non-gem quality, the controlling organization is devoting major attention to widening the industrial field of application of these lower-grade stones. A special factory has been set up in Belgium for the purpose of experimenting with diamond-impregnated wheels for the cutting of various kinds of rock. Similar research work is being conducted at the University of the Witwatersrand in Johannesburg, where cutting wheels of reported high efficiency have been made by admixing powdered diamonds with iron, cobalt, and other metals. It is claimed that such wheels will readily cut corundum, the next hardest mineral to the diamond. So far, the principal use to which the wheels have been put has been in the preparation of rock specimens for microscopic examination.

HIGHWAY TUNNELS

THE increasing use of tunnels in the construction of mountain highways is evidenced by the fact that there are now more than 35 of them in the western part of the United States. In a comprehensive report published in *Public Roads*, various aspects of these bores are discussed and detailed information is given regarding a number of them. The longest of them is a 5,613-foot tunnel on the East Rim Road in Zion National Park, Utah, and eleven others are each more than 500 feet long.

The determination of whether a certain section of road should be carried through a tunnel or an open cut is arrived at after a careful study of the probable costs of each. The need of portal structures is usually a major factor in deciding whether a short tunnel is justified from an economic standpoint. Assuming the average cost of portals to be $4,000 each, with the critical depth of cover between 80 and 100 feet, the economical minimum length of tunnel, based on average excavation and lining costs, is in excess of 80 feet.

Tunnels have three principal advantages over open cuts: reduced curvature and length, with consequent greater travel safety; practical elimination of snow-removal expense and reduced maintenance cost, except where special lighting and ventilating facilities must be provided; reduced scarring of the landscape and prevention of erosion.

All tunnels longer than 1,500 feet and, under certain conditions, shorter ones, must be ventilated to keep the percentage of carbon monoxide in the air at a safe point. In some instances galleries, driven at right angles to the tunnel line, introduce both air and light and provide natural ventilation, and in others shafts are sunk connecting the tunnel with the open air, thus obviating artificial ventilation. Either of these schemes adds to the construction cost. Galleries are favored in scenic areas such as the national parks because they afford travelers attractive views, although they tend to slow up traffic.

The cost of tunneling is influenced by many variables. The kind of rock to be penetrated is perhaps the most important item among these, not only from the standpoint of excavating cost but also because it determines to a great extent whether timbering is necessary during construction and whether the bore must be lined afterward. Careful study of the geology of the section under consideration is always desirable; and in some locations it is advisable to open one or both faces for a short distance to ascertain whether or not the material is uniform.

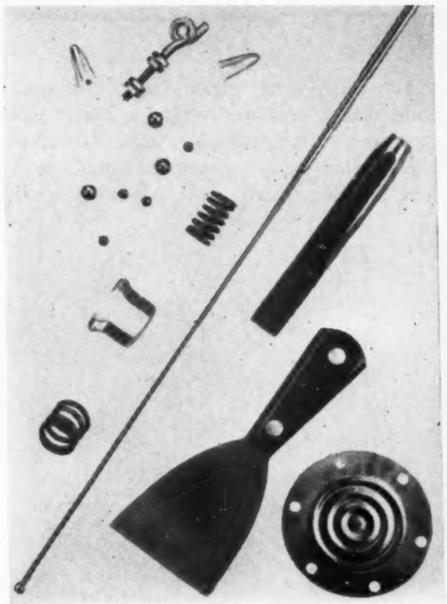
Because lighting in tunnels is none too good at the best, the tendency is to make their roadways wider than those in the open in the interest of safe driving. The construction of the East Rim Tunnel was started in 1927, and provision was made for a driveway only 20 feet wide. This is considered inadequate, and later tunnels have been built with roads 24 to 27 feet wide. Some tunnels also include walkways.

The U. S. Bureau of Mines has been consulted on the design of ventilating equipment for all tunnels driven by the U. S. Bureau of Public Roads. Tests indicate that the average automobile, on a grade of 4 per cent or less, will exhaust 1.5 cubic feet of carbon-monoxide gas each minute. To be on the safe side, it is assumed that it will give off 2 cubic feet in that period. As 2 parts of this gas in 10,000 parts of air is considered the maximum safe concentration, it is the practice to introduce into a tunnel 5,000 cubic feet of fresh air each minute for each car going through it.

Proper Illumination Facilitates Ore-Picking

ADEQUATE lighting of ore-picking belts has an important bearing on the amount of rock that can be handled by the sorters in a given time. Such, in effect, is the summary of a report made by the British General Electric Company, Ltd., of Johannesburg, after a series of investigations conducted by it in mines on the Witwatersrand. It was determined that daylight during the early morning hours is more suitable for the work than afternoon light because of its characteristic color, and that daylight-blue, gas-filled electric lamps shed a better light for the purpose than do vacuum electric lamps. Those of the Osira type were found to possess the desired qualities.

The approved system is so arranged that it is switched on automatically as soon as the intensity of daylight drops to a point equivalent to 150 candlepower. This is done by means of a photoelectric cell which operates contacts in the lamp circuit. The experiments have indisputably proved that with proper illumination at all times it is possible to deliver the ore on faster moving conveyor belts and for the sorters to separate the values from the worthless material with far greater accuracy and without eyestrain.



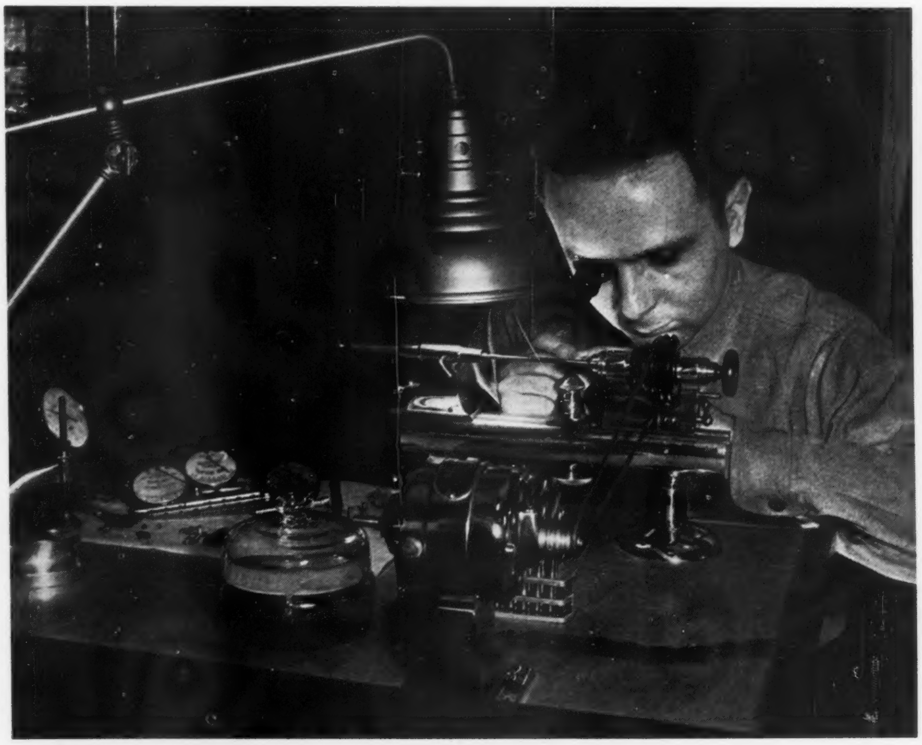
MISCELLANEOUS PRODUCTS

A few of the things fabricated from "Z" Nickel wire, rod, and strip. From top to bottom—loop with threaded shank, balls, flat and coil springs, automobile aerial tip, scraper, chisel, and diaphragm.

New High-Strength Nickel Alloy

FOR parts that must be strong, hard, and tough like tempered steel and at the same time rustproof and resistant to corrosion, the metallurgist has produced an alloy called "Z" Nickel that, it is claimed, can be hardened to a point where it will be 2½ to 4 times stronger than structural carbon steel. This new product contains a minimum of 98 per cent nickel, and is available in hot-rolled or cold-drawn rods, wire, and cold-rolled strip in a wide range of sizes and either in hardened or in soft form suitable for fabrication and subsequent hardening. For example, cold-rolled strip may be had in soft, half-hard, or full-hard temper corresponding, respectively, to minimum tensile strengths of 90,000, 130,000, and 155,000 pounds per square inch.

In the unhardened or quench-annealed condition, the alloy lends itself as readily as does rolled nickel to bending, drawing, machining, and hot forging. Depending on the hardness of the metal before heat treatment, hardening is effected at temperatures ranging from 890° to 930°F. in from six to sixteen hours; and because of these comparatively low temperatures the work is done, it is said, with little if any distortion of fabricated parts. The resultant material has a tensile strength varying from 150,000 to 250,000 pounds per square inch, a hardness up to Rockwell C 46, exceptional ductility, and good electrical conductivity. "Z" Nickel is naturally white in color, and, because of its diversified properties, promises to meet a wide variety of needs in the electrical as well as in the mechanical field.



STEEL-WORKS WATCHMAKER

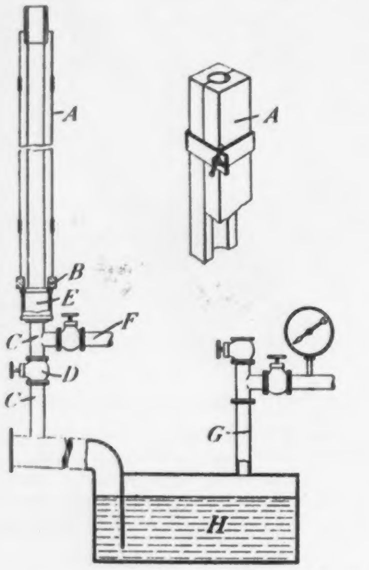
G. B. McGarvey at work in his shop in the Pittsburgh tube mills of the Jones & Laughlin Steel Corporation, repairing precision gauges used for checking the pitch, taper, and depth of the threads on each end of seamless oil-well casing. The gauges, of which more than $250,000 worth are in use in the company's works, are generally similar in construction to watches. As the measurements made with them must be accurate to within one one-thousandth of an inch, the gauges are continually inspected and repaired and periodically checked against master gauges in the U. S. Bureau of Standards.

Improved Oil-Field Process

TO William H. Vaughan of Palestine, Tex., has been granted a U. S. patent covering a new process embodying an advanced application of refrigeration to the extraction of hydrocarbons from natural gas. In addition to the refrigeration and extraction phases, it involves the return to the ground of expelled gas to maintain pressure in the producing formation. It is expected that this process will result in an increased yield of oil from a given field and also in greater economy of production. It promises to be of particular importance in connection with oil discoveries at great depth, with consequent high pressures. Where a highly saturated gas is developed in a region having a limited gas market, indications are that it will make it possible to place such a property on a revenue basis quickly. The Tide Water Associated Oil Company and the Seaboard Oil Company of Delaware are now jointly operating an experimental plant utilizing the process. Preparations are being made to expand the activities of the plant by the addition of more equipment, including two Ingersoll-Rand XVG gas-engine-driven compressors. One of these units is of 300 hp. and the other of 225 hp.

Industrial Notes

By the simple expedient of forcing a fluid plastic repeatedly into a 2-part mold having a cylindrical bore, a British inventor claims that it is possible to make seamless, flexible, smooth-bore tubes of any de-



Courtesy, The Engineer.

STRUCTURAL FEATURES

A, mold; *B*, supporting frame; *C*, pipe connection; *D*, valve, which is closed when hot air for drying film is admitted; *E*, sight glass; *F*, hot-air pipe; *G*, compressed-air line; *H*, tank.

sired diameter suitable for handling various liquids such as gasoline, benzine, oils, etc. The apparatus used consists of the split mold, which is square in cross section and held together by metal straps, of a pressure tank, and of connecting piping, valves, and a sight glass. The plastic, of which the tube is formed, and which can be varied according to service requirements, is forced under the pressure of compressed air up into and to the top of the mold, which is mounted in an upright position. Pressure is next released so as to allow the viscous fluid to flow back into the tank. The film that adheres to the inner surface of the mold is then dried by passing heated air through it. This process is repeated until the tube wall has been built up to the desired thickness. The system is patented and is an adaptable one, as it permits several tubes to be made at one time.

Oil cans with transparent bodies are to be had in sizes ranging from ½ ounce to ½ pint. They are made of a plastic material that is said to be unbreakable and not affected by oil or gasoline. They are marketed under the name of Scan-Can, and are available in white, amber, blue, green, and red and with either metal or transparent spouts.

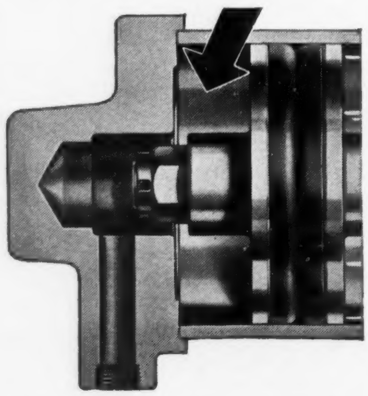
A new process developed in England for the manufacture of activated carbon from bituminous coal is said to reduce the cost of production. It calls for the use of graded lump coal, thus eliminating the preparatory work of grinding and briquetting. The resultant carbon is suitable for use in gas masks and for certain industrial purposes.

It has been announced by E. I. du Pont de Nemours that it is ready to license manufacturers to use a high-speed copper-plating process developed by it. The usual cyanide-plating equipment is suitable for the purpose, but the work is done at a much faster rate than by the older method. It is claimed that coatings of uniform brightness and free from pits, ready for the application of dull or bright nickel, can be deposited in thicknesses ranging from 0.001 to 0.003 inch in from ten to twenty minutes.

The Scotch contractor expects to make a nice profit on this job.

The large library of films maintained by the U. S. Bureau of Mines for the benefit of educational and other institutions has lately received a valuable addition in the nature of a 6-reel motion picture of the silent type that tells the story of copper in a comprehensive and entertaining manner. The first three reels are entitled *Copper Mining in Arizona*, and deal with both open-pit and underground methods of extracting the ore. The other three show the various processes by which it is successively leached and concentrated, smelted, and refined for the market. The film is available in either the 16-mm. or the 35-mm. size and can be borrowed for purposes of exhibition by civic and business organizations, schools, colleges, churches, etc., which must bear the cost of transportation. Applications should be addressed to the Bureau of Mines Experiment Station, 4800 Forbes Street, Pittsburgh, Pa.

The Galland-Henning Manufacturing Company, makers of single- and double-acting pneumatic cylinders with adjustable cushion-heads has announced that it is prepared to supply a full line of cylinders of both types with nonadjustable cushion-heads. The only difference between the two is that in the one case the air cushion at the end of the piston stroke remains



PNEUMATIC CYLINDER

The arrow points to the nonadjustable air cushion provided for at one or both ends of this new type of air cylinder. The cushioning effect is obtained by a hub on the piston which enters a port in the head and thus prevents escape of the air remaining between the cylinder head and the piston.

positive while in the other it can be increased or decreased to meet service demands. Both are designed to prevent the noisy and destructive metal-on-metal impact unavoidable with air cylinders that are not cushioned. This improvement in construction makes for smoother and more efficient operation, prolongs the service life of the piston and cup leathers, and reduces cylinder maintenance costs. The Nopak air cylinders, as they are called, are fully described in an illustrated bulletin which can be obtained from the company by writing to 2727 South 31st Street, Milwaukee, Wis.

Safety belts for steel erectors! Not a bad idea. They were worn by the workmen who built the huge steel forms for the pier noses on Dam No. 17, one of a series being constructed in the upper Mississippi River under the supervision of the U. S. Engineer Department.

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INDEX to VOLUME XLIV

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COMPRESSED AIR MAGAZINE

INDEX TO VOLUME XLIV

JANUARY-DECEMBER 1939

A

B

C

D

E

F

G

H

I

J

L

M

N

O

P

Q

R

S

T

U

V

W

Y
